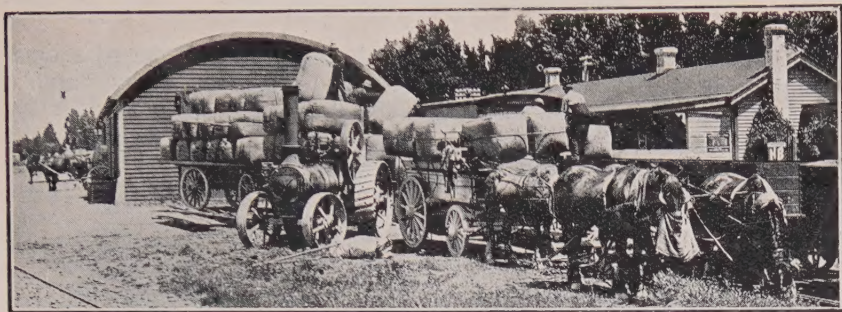




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THE GRASSLANDS OF NEW ZEALAND.

PRINCIPLES OF PASTURE ESTABLISHMENT.

(Continued.)

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TRANSITION OF PASTURES.

CHANGES or transitions must be duly recognized in grassland economy, and before further types of country are considered an endeavour will be made to get a better idea as to what constitutes a transition, and to view a few of the ways in which such transitions come about.

In our pasture-plants we are dealing with living organisms—plastic, it is true, yet with limitations. The same plant may be grown more or less successfully under many varying conditions and be subjected to differential treatment, and yet may persist; but a point may be reached when the limiting factors to growth have so accumulated that the plant is no longer able to persist, and it “goes out.” All the species of plants used in our pasture-work are more or less dissimilar; their growth-forms and their power to adapt themselves to the different soils and surroundings vary. Some establish themselves very rapidly, while others are much slower to germinate and to get a good grip of the soil. During that period they may be easily killed. Some like to grow alone by themselves, others like to combine with other species; some are

shade-endurers, some cannot tolerate shade; some prefer the open sunny knolls, some the damp hollows; some are free-seeding annuals, others perennials which rely mainly on their vegetative portions by which to propagate themselves. All are more or less foreign to the location, there having been in natural New Zealand no grasslands such as we see around us to-day. Therefore in a newly-sown-down pasture, which may be composed of some eight or ten species, one can easily imagine competitions being set up. The struggle for existence rages from the offset. Each plant is competing with its neighbour to occupy more and more ground. The strongest, most aggressive species will survive. This leading-up to the survival of the fittest may involve many changes in the composition of the pasture, and to these changes is applied the term transition, while each respective type of vegetation that appears in that transition is termed a succession.

In the early stages of the history of the pasture the dominant element may be of a temporary nature. It runs its course and then it goes out, in many cases leaving bare ground; or it may have so reduced the vigour of the desirable permanent elements that they are too weak to recover and to fill out over that ground. Weeds perfectly attuned to that location then come in and an undesirable succession arises. The succession may come about rapidly, or, on the other hand, it may take many years to form and to become stable or fixed. The transition may be cataclysmal, as when forest or grassland is overwhelmed by a moving sand-dune; or there may be a slow gradual merging or rearrangement of species to form the mixed association; or aggression by a dominant to form the pure association; or reversion to form the natural or original vegetation; or replacement to form an association wholly different to that sown or intended; or denudation, resulting in the complete annihilation of all vegetation from off that soil-surface.

Transitions may be divided up roughly into two great classes—(1) topographical, and (2) biological. Changes which arise in virtue of an entirely new soil-surface replacing the old are termed topographical. Such arise when a sand-dune spreads over neighbouring lands; or, more slowly, when a river by overflowing its banks silts up the plains over which it floods; or, more rapidly, when a new soil-surface is erupted from a volcano. All other changes are biological, because they are all dependent on or are governed by phenomena of living organisms—bacterial, plant, or animal—the environmental conditions governing those forms of bacteria, plant, or animal that may persist.

All biological transitions are subject to modification, and one of the phases of pasture-study is accurately to gauge the effects of each factor operating to influence any one such transition that may come about. There are two outstanding questions: (1) What are the factors which govern the destiny of our grassland associations? and (2) What considerations should we give to so constitute and govern our pasture that undesirable successions may be avoided, and that each respective transition be so governed that each successive stage in that transition may be of economic value? The writer does not claim to be able fully to answer these important questions, nor is it possible to answer them fully without more, and more definite, research work. It remains a fact, however, that transitions in our pastures must be recognized



FIG. 10 (OF SERIES). SHOWING RAPID GROWTH OF PERENNIAL AND ITALIAN RYE-GRASS
A FEW WEEKS AFTER SOWING.



FIG. 11. A WELL-CONSTITUTED PASTURE IN ITS THIRD YEAR, COMPRISED MAINLY OF
COCKSFOOT, CRESTED DOGSTAIL, PERENNIAL RYE-GRASS, TIMOTHY, AND WHITE
CLOVER.

Combination of species here has been carefully studied, and a closed turf has resulted.



FIG. 12. A POORLY CONSTITUTED PASTURE, FOUR YEARS OLD, WHERE TRANSITION HAS SET IN.

The temporary elements have run out, leaving isolated cocksfoot-plants with more or less bare ground between.



FIG. 13. NATURE'S SELECTION OF A PLANT-FORM TO COVER A DRY RIVER-BED SHINGLE DEPOSIT—A CUSHION-LIKE PLANT (*RAOULIA LUTESCENS*) MOST FITTED TO SURVIVE UNDER THIS EXTREMELY DESICCATING ENVIRONMENT.

and faced by farmers. Pure sowings of permanent grasses in many cases could be secured right from the offset, but the expense of seeding would be too great. Thus 30 lb. per acre of cocksfoot-seed is required to form a complete turf soon after sowing; moreover, in order to cope with weed-competition a vigorous-growing grass to start off with is imperative. It is of high importance, however, that the temporary elements are so regulated that they do not crowd out slower-establishing permanent grasses and clovers. The changes must be guided, and it is for the farmer to so guide and regulate the seeding and stocking that undesirable successions are avoided. Just how some of these changes take place may be illustrated in following out the life-history of any one type of pasture.

A field is sown down to permanent pasture, say, on land that is not quite first-class. It is sown down with seven or eight species of grasses and clovers, some more or less annuals, some perennials. The purely temporary element—Italian rye-grass—leads off, followed by perennial rye-grass. These two may entirely cover the ground (Fig. 10), and may make such luxuriant growth as to cause the farmer to rejoice at the excellence of his young pasture; but, none the less, there is a deadly and uneven contest waging in that field. Beneath the rye-grass cover the more slowly establishing species are striving to reach the sun. Those which cannot reach it rapidly succumb. Others by abnormal elongation of their shoots may succeed in living, but these are weakened by the efforts to rise, and are quite unable to tiller out in the manner normal to their species. Thus, when too much rapidly grown and short-lived element is included in the sowing the life-history of a pasture—as far as a productive pasture is concerned—may be an exceedingly short one. In a well-constituted pasture (Fig. 11), however, it will be assumed that all the species have established and that each is figuring in the pasture association—perennial rye-grass, Italian rye-grass, cocksfoot, crested dogstail, timothy, red clover, white clover, &c. In two or three years' time, on the class of soil under consideration, the rye-grasses and red clover will have run out, and it is at the end of this period that is realized the need for the inclusion of the permanent elements, and for taking precautions to ensure that they become established. If they are not there to carry on, bare ground will appear as the temporary elements die out, which bare ground will soon become occupied by inferior grasses or other weeds. Or if the permanent plants are not present in sufficient numbers and varieties, those that are there may be established all right, but bare ground will have appeared around about them (Fig. 12). Sufficient plants are not left to form a continuous sward, and when this results (particularly so in the case of cocksfoot pastures) the bare ground is not only a direct loss as far as the feed-production of the pasture is concerned, but also in that the bare ground bakes and cracks, thus resulting in a direct loss of soil-moisture which is so essential to the well-being of the plant. The cocksfoot-plants become tussocky; the drying winds get well around the basal portions of the plant from which ordinarily the new roots arise, and the plants become elevated. They are then readily pulled or knocked out by grazing stock, or grazed so bare to the crown that in the course of a few years the cocksfoot dies out and disappears from the pasture. On land eminently suited for cocksfoot the process is



FIG. 14. BARE GROUND BETWEEN COCKSFOOT TUSSECKS OCCUPIED BY HAIR-GRASS, A USELESS ANNUAL GRASS.



FIG. 15. ASSOCIATION OF RIB-GRASS AND CATSEAR IN A FIVE-YEAR-OLD PASTURE.

Rib-grass and catsear may enter the breach formed by the dying-out of *Agrostis* (see Fig. 18), or these may enter into the original bare ground.



FIG. 16. PASTURE FIFTEEN YEARS OLD, MAINLY CATSEAR, FIELD-DAISY, OX-EYE DAISY, RIB-GRASS, AND RED-TOP, WITH FIELD-DAISY BECOMING DOMINANT.

Field-daisy, owing to its free-seeding attribute and short-tillering rootstock, may form a pure association.



FIG. 17. CATSEAR SUCCESSION IN PASTURE TWENTY-FIVE YEARS OLD.

Showing a natural habitat secured by catsear, resulting in a pure association of this plant.

much slower, but, even so, the elevated tussock is so exposed to drying winds that the feed produced is small.

There are very few places which nature cannot clothe with some sort of vegetation. It is her endeavour to clothe all soil-surfaces with some type of growth, and it will be with the kind of vegetation most fitted to occupy that particular location, whether useful or otherwise. These bare patches which appear in the pastures therefore do not remain bare ground for long, and according to the location of the pasture so will be the type of vegetation with which nature repopulates that soil. On the poorer and drier soils it will be with hair-grass, or sweet vernal, or goose-grass, graduating towards the wetter locations into rib-grass, catsear, *Agrostis*, Yorkshire fog, or field-daisy (Figs. 14, 15, 16). All are inferior plants, capable either by their free-seeding attribute or strong stolon-development of becoming very aggressive, and finally they dominate the association. They are, generally speaking, of low palatability, hence what remains of the desirable constituents is the more rapidly eaten out, and so in one way or another an entire replacement comes about. It may be a pure rib-grass replacement, or one of pure *Agrostis*, or of pure field-daisy. Each will be more or less permanent if the conditions are essentially favourable, or, in other words, if natural habitat has been secured (Fig. 17). On the other hand, however, favourable conditions for the continued growth of these weed-plants may not be maintained, and a further change will take place. Such is the case with certain grasses, such as red-top, twitch, &c. They do very well and produce quite an appreciable amount of feed while the ground is loose, but just so soon as consolidation takes place the yield falls off, the turf becomes sod-bound, and the grass sooner or later dies out in the central and older portions (Fig. 18). In this way a fresh opening is afforded for other plants to enter. Generally speaking, it will be *danthonia* which comes into the breach thus formed (Fig. 19), and this grass may prove a permanency for a great number of years. All these successions, however, must be looked upon as undesirable ones wherever the land may be ploughed; they are but examples of many that may arise even on ploughable level country.

The steep hillsides afford many more types of succession. Here the factors at work are more potent, and the need for greater knowledge more pressing, for it is impossible for the plough to get to work and make a fresh seed-bed once undesirable successions do take place in this situation. An undesirable succession will mean a reduced carrying-capacity, and in many cases the complete abandonment of those areas for a long period of years, until such time, in fact, as a fresh covering of natural vegetation, such as fern, &c., has been produced, enabling the area to be fired and a fresh seed-bed thus secured.

Behind all these transitions and successions must be recognized a great principle—namely, the persistence of a natural force, the force of environment, a force to which all nature is subject, and subject to a varying degree. Nature, it is found, always goes hand-in-hand with this environmental force, and moulds her forms, whether plant or animal, according to the strength of that force. Just so soon as the resistance offered by the plant is greater than the environmental force that plant will persist and thrive, and in our pasture-work we must either select plants naturally imbued with this power to persist, or



FIG. 18. SIX- TO EIGHT-YEAR-OLD PASTURE IN WHICH RED-TOP (*AGROSTIS*) HAS COME IN AND DISPLACED THE MORE USEFUL ELEMENTS.

On the left of photo the red-top has become sod-bound and is dying out, making possible the entry of new species.



FIG. 19. *DANTHONIA* SUCCESSION. *DANTHONIA PILOSA*, ON LEFT, DISPLACING AN ASSOCIATION OF RIB-GRASS, FIELD-DAISY, AND OX-EYE DAISY.

Here conditions have not been entirely suitable for the continued prosperity of the association shown in Fig. 16, and *Danthonia pilosa* has entered as a competitor.

assist other plants, through artificial means, by lessening the force of the environment. The delicate flowers in our gardens are able to persist there not in virtue of their own inherent powers to occupy that location, but because the gardener, by his energies, alters very considerably the surrounding conditions, and thus creates a new environment with a much-reduced desiccating force. We may sow the seeds of plants, but whether those plants will persist depends entirely on their environment, or on their ability to modify themselves according to that environment. Our pasture-plants do not show marked capacity in this latter respect, and unless the farmer, by manuring, chain-harrowing, &c., and by regulating his stocking, is prepared to control to some extent the conditions under which those plants are to grow, or, in other words, to modify the environment, it is utterly useless to expect any but the grasses natural to that soil to be of a permanent nature.

Some points on pasture-management to be considered later may serve to show how changes in our pastures may be controlled and the transitions guided, so that there takes place a gradual replacement of the temporary and short-lived elements, not by weeds or useless plants, but by those which are of use to the farmer.

(To be continued.)

LEMON-CULTURE.

DIRECTIONS FOR NEW ZEALAND GROWERS.

(Continued from June issue.)

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DISEASES AND INSECT PESTS.

THE control of insect pests and fungus diseases is possible only when trees are otherwise well cared for. A crowded state of tree encourages pests, and renders treatment very difficult. Dead wood is devitalizing to the tree, and breeds disease; all such should be removed, cutting down to sound wood. A proper system of cultivation, the application of fertilizers where necessary, attention to drainage, and the maintenance of clean surroundings are important factors, and should be regarded as the first line of defence against diseases and insect pests of all kinds.

Brown rot (Pythiacystis citrophthora).

This is admitted to be the most troublesome fungus disease of the lemon that we have to deal with. Essentially a soil fungus, all infections come first from the soil. The fungus does not produce spores on fruits on the tree, but can do so if the fruit falls on to wet soil. The fungus can, however, be communicated from fruit to fruit, but only by contact, the fungus plants having the power to root on other surfaces with which they come in contact. It is a wet-soil fungus; it dies in dry soil. If, therefore, the surface soil be frequently stirred so as to dry it, while the weather remains dry there will be no brown-rot. In dry climates, such as Hawke's Bay and Central Otago, no great difficulty

should be experienced in preventing infection during the greater part of the year. A careful watch should be kept for any fruits infected during wet periods, and such fruits should be gathered and destroyed. Fruits near the ground are most liable to infection, therefore they should not be allowed. All growths should be cut off to a height of 2 ft. above the soil, so as to prevent infection by splashing from rain falling on the soil. In California it is a custom to grow cover-crops during the wet season to prevent the zoospores being splashed by rain on to the trees. (A full account of this disease and methods of control was published in the *Journal* for May last.)

Verrucosis (Cladosporium Citri).

This disease, which is also known as lemon and orange scab, is indicated by the presence of warty excrescences on the fruit and leaves. The warts may be few or numerous, small or large. The warts become covered with a delicate mould, grey at first, then dusky, finally black. Trees growing in low, moist situations are most subject to the disease—in fact, for its development and spread the almost constant presence of moisture in the air is required. The disfigurement frequently becomes so great as to enormously depreciate the value of the fruit, often rendering it unsaleable. By damaging the foliage the disease also debilitates the trees.

Prevention rather than cure is recognized to be the principal aim in fighting fungus diseases, and this applies very particularly to verrucosis. While the moderate use of bordeaux mixture or lime-sulphur in the spring and autumn is sufficient to maintain free of contamination a grove otherwise well cared for, nothing short of a very drastic spraying programme can be relied upon to give satisfaction in cases where through neglect the disease has become firmly established. Bordeaux, 4-4-40, or commercial sulphur, 1-40 or 1-50, are the materials to use, the former for preference. Three or four applications should be made at intervals of three weeks, commencing when the main crop has set, and further sprayings are advisable in the autumn. In the case of normally clean and healthy trees one or two sprayings with bordeaux on the lines recommended will be sufficient to ensure a reasonably clean crop of fruit.

Melanose (Phomopsis Citri).

Melanose affects the fruit, young shoots, and leaves. The appearance is the same in each case—small brown spots which are scattered like pepper over the skin of the affected part. The spots are wax-like in appearance, resembling small drops of sugar burned to a reddish-brown. They are raised and cap-like, and the affected surface is rough to the touch. Where the spots are plentiful they will grow together, forming solid patches irregular in outline. These patches will crack in lines like dried mud. Some of the markings may be arranged in lines forming circles or parts of circles, these circular arrangements being characteristics of melanose. The disease attacks only young and succulent tissues; as the fruit approaches maturity it becomes immune. The disease usually starts in spring, but may occur much later in a season of flush growth. Melanose greatly disfigures the fruit and prevents it developing, resulting in unattractive and undersized fruits..

Spray with 4-4-40 bordeaux just before the trees blossom, and again when the fruit has set.

Anthracnose (Phoma citricarpa).

This disease is also known as black-brand and black-spot. The appearance of affected fruit is very characteristic—a number of irregular-shaped depressed spots that look as though they had been burned with a hot iron. The remedy is to spray with bordeaux.

Grey-scab (Sporodesmium griseum):

Small grey or dusky spots on leaves and fruit characterize grey-scab. These spots gradually increase in size and fuse together, forming well-defined patches. The disease is controlled by bordeaux spray; the treatment [applied for verrucosis, &c., should also keep grey-scab under control.

Collar-rot (Fusarium Limonis).

This destructive disease is unfortunately very prevalent, and is likely to remain so until methods of culture are generally improved. Well-drained soil and thorough cultivation are necessary. In some instances groves are planted on badly drained or otherwise unsuitable soil, with the intention of improving conditions at a later date. This is simply courting disaster. In very few cases can the necessary improvements be effected after the trees are planted; the work should be done before planting. In some cases the soil is quite unsuitable for growing citrus fruits, and no amount of preparation can make it otherwise.

The stock on which the plants are worked has an influence on collar-rot. It is generally admitted that trees raised by layers or cuttings are those most subject to attack. The first evidence of the presence of the disease is a sickly appearance of the leaves; these turn yellow, and the tree may begin to die from the top. This condition may be observed before there is any other manifestation. The disease may start at the collar of the tree, just above the soil, but more generally it starts in the roots and works up to the collar.

If a tree is badly affected nothing can be done to save it, and it should be dug out—roots and all—and burned. The soil should have a good dressing of quicklime before another tree is planted. If only one or two roots are attacked the affected roots should be cut off, traced to their extremities, dug out, and the soil well limed. Sometimes only the collar is attacked. In this case the ruptured bark should be cut away as far as it extends to the roots, cutting back the diseased bark till green healthy bark is reached. If the wood shows discoloration, with gum exuding, this should be cut or scraped away. A blacksmith's shoeing-knife or a draw-shave is useful for this purpose. After cutting away, leave it for a day or two, and if more gum then exudes scrape again. When no gum exudes clean and dress the affected part thoroughly, swab well with corrosive sublimate, and finally paint over with coal-tar.

Bark-blotch (Ascochyta corticola).

This destructive disease has till quite recently only been recorded as occurring in Australia, but its occurrence in New Zealand has now

been noted, and recently two decided outbreaks have taken place in the Auckland District on trees imported from Australia. In one case it is suspected that the affected tree is from a layer. The effect of this disease is the same as in collar-rot—trees die back from the top and present a sickly appearance. Bark-blotch, however, is easily distinguished from collar-rot. There is no gummy exudation; the bark splits and lifts from the wood, which does not occur with collar-rot. Treatment is the same as for the latter, except that the wood, after removing the bark, should be only lightly scraped.

Mottle-leaf.

This affection is a malnutrition disease caused by an insufficiency of plant-food of the proper kind or in an available form. The evidence of the disease is mottled leaves due to a lack of chlorophyll, which is the green colouring-matter. The leaves exhibit yellow areas of varying extent. The presence on a tree of a few mottled leaves is not of much moment, but it serves as a warning that there is something wrong. If a tree becomes much affected it suffers a general weakening and ceases to thrive, growth becomes stunted, and the tree presents an unhealthy appearance. Investigators agree that the cause is deficiency of nitrogen, but the application of nitrogen in any form does not effect a cure. The need appears to be humus, which, as stated earlier, is specially necessary for citrus-trees. It is not considered, however, that humus effects a cure because it is humus, but because of the effect it has on the availability of the various plant-foods in the soil, especially on the nitrogen contents. Extensive experiments made in America show that the humus contents of the soil have a distinct bearing on mottle-leaf, this condition disappearing when the humus content is sufficient.

Sooty Mould (Capnodium citricola).

Sooty mould is a fungus that grows on the secretion of certain scale insects. Get rid of the scale and the fungus will disappear.

Cottony Cushion Scale (Icerya Purchasi).

This insect can easily be distinguished from any other by the large white ovisac (egg-case) which makes it very conspicuous. The ovisac is longitudinally corrugated or fluted, which adds to its distinctive appearance. *Icerya Purchasi* is one of the most destructive insects known, and an enormous amount of damage has been done by it in America, Cape Colony, and elsewhere. It has proved to be a most difficult insect to control by spraying, although modern methods have been more successful than some formerly in use. The scale was introduced to this country from Australia; it increased amazingly, and about forty years ago was doing a very great amount of damage. It attacks almost every shrub and tree, including pines, and even common gorse, but shows a decided preference for the silver-wattle. About the period mentioned it was discovered that a very small red-and-black ladybird beetle, *Vedalia (Novius) cardinalis*, feeds voraciously on this scale. This is true of both the larvæ and adult beetle. Colonies of the ladybird were introduced from Australia, and in a very short time *Icerya* was reduced to negligible numbers. The same ladybird

was taken to America with like results, and forms the principal means of control in the United States.

Although spraying is not the best means of control, it must at times be resorted to. The scale is considered to be the sole food of the ladybird, consequently if the scale insect becomes very scarce the ladybird may disappear. In such cases, if the scale again becomes troublesome, spraying is necessary, though endeavour should also be made to reintroduce the ladybird to the affected locality. Contact sprays, such as red-oil emulsion, McDougall's Insecticide, or lime-sulphur, are useful in destroying the newly hatched scale.

Black Scale (Lecanium oleae).

Black scale has at times been a very serious pest. Colonies of the steel-blue ladybird, *Orchus chalybus*, introduced by the Department from Australia, were liberated in places where the scale was most numerous and almost exterminated the pest. The numbers of the ladybird fluctuate, and at times transport from one district to another becomes necessary. It is doubtless due to the ladybird that the *Lecanium* scale is not a more serious pest.

Other Scales.

Other scale insects common on citrus-trees are the Citricola scale (*Aspidiotus coccineus*), the round black scale (*Aspidiotus Rossii*), and a native scale (*Diaspis Santali*), also the near-related mealy bug (*Dactylopius adonidum*). Spraying must be resorted to for the control of these insects as well as those previously mentioned. The trees being evergreen, a solution strong enough to destroy matured scales cannot be employed, and the young insects must be attacked. For this purpose red-oil emulsion, 1-40, is effective. The insects do not all hatch out at one time, and this spray will not kill eggs. Therefore several sprayings are necessary, and frequent observation with the aid of a pocket-lens to determine when the young insects are moving.

Black Aphis (Myzus cerasi).

These minute insects attack the young growths. If left unchecked they quickly do a considerable amount of damage, causing young shoots to wither and die. McDougall's Insecticide, 1-50, has proved quite effectual in the control of the aphid. Other remedies are lime-sulphur, 1-125, and Black Leaf 40, 1 pint in 100 gallons of water.

Leaf-roller (Tortrix excessana).

This caterpillar at times does a considerable amount of damage by destroying young shoots and blossoms. Spray with arsenate of lead, 4 lb. paste or 2 lb. powder to 100 gallons of water.

Thrips.

There are a number of species of thrips, which may be black, brown, or yellow, but they are always very small, and long in shape. Thrips attack a great many plants, affecting leaves and blossoms, and are regarded as difficult insects to get rid of. They are most prevalent during a dry season. Red-oil emulsion, 1-40, is recommended for control.

Borers.

The larvæ of several species of beetles do considerable damage. Some species lay their eggs on the trunk or main branches. The remedy in the first place lies in keeping the tree open, so that the borings can be detected before serious damage is done. When detected in time the grubs can be destroyed by injecting benzine, or they may be reached with a wire. The hole should then be plugged with a spill of wood or with hard soap. If the trunk and main limbs are given a good coat of lime-sulphur in early spring it will prevent the beetles depositing their eggs thereon. Other beetles deposit their eggs on small twigs, and the first sign is dead leaves on the twig. As soon as these are seen the twig should be cut off and the borers destroyed, as if left they work their way down and do a good deal of damage. Trees that are kept open, properly pruned, and sprayed are not much affected by borers.

General.

The control of mealy bug and other insects by fumigation is not here dealt with. The cost of covering-tents is very heavy, and very exact calculations are necessary to ensure effective work without injuring the trees. The great amount of labour involved in fixing the tents, &c., makes growers unwilling to operate until the trees become badly infested, and this alone is a serious objection to the method. Hitherto the difficulty has been to find an effectual method of spraying that will not injure the trees. Recent extensive experiments carried out in various parts of Australia have shown some unexpected results. For instance, trees when in a semi-dormant state, instead of being able to bear stronger sprays, as was thought to be the case, are in that condition particularly susceptible to injury. It appears that a healthy tree in full growth may be sprayed without injury, but a tree that is not in a healthy state, or a healthy tree when not making growth, is liable to be injured. This throws fresh light on the question of spray injury, and points to the safe method of controlling insects by attacking them when newly hatched in the manner previously described.

Frost is at times responsible for a good deal of injury to both fruit and foliage. Careless mixing of spraying-material is a common cause of damage, leaves being spotted or even caused to fall. A gale of wind may also damage the foliage, burning the edges and spotting the epidermis. Spray damage can usually be prevented by careful mixing. The formulæ advised should be carefully adhered to, remembering that a little carelessness may result in a large amount of injury. Careless mixing of sprays is like playing with fire, which is a good servant but a bad master.

(To be continued.)

Barley as a Horse-feed.—This grain, if fed liberally, is liable to produce laminitis or founder, and digestive trouble. If fed at all it should be used sparingly at first till the horses get used to it. In India, where it is the staple grain feed, it is "parched" before being fed. Generally speaking, if oats are available barley is not to be recommended, taking its cost as well as its suitability into consideration.

COMMERCIAL POTATO-GROWING.

(Continued.)

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DIGGING.

IN order to take advantage of an early market potatoes may be dug a little on the green side, but if they have to be shipped it is not advisable to do this, for with so much handling, together with storage in a close hold, such tubers may be expected to arrive badly skinned and yellow. For ordinary marketing it is much better to allow the crop to thoroughly ripen before digging. When ripening, the shaws or tops gradually turn yellow and finally die. In order to ascertain if the potatoes are ready for digging a top can be pulled here and there, and if these come away without tubers attached the crop is ripe. Another test is to dig out a hill here and there, rub the tubers fairly hard with one's thumb, and if the skin can be displaced the crop is not ready for digging. Digging should be undertaken as soon as the crop is ready, enabling it to be stored or marketed before the winter rains and frosts come on. The grower can then get his field raked and all rubbish burnt (no small item with a large crop and area), also a following crop prepared and sown.

I would decidedly advise growers of 5 acres and upwards to use a machine digger. Digging is done quicker, cheaper, and cleaner than by hand, also the cultivation of the land is much more thorough. This stands to reason, for while hand diggers only dig out the hills, the machine digs and shakes everything. The tilth after the machine digger has done its work is so thorough that a crop may be sown without ploughing, merely running a cultivator over the field and then sowing. I have seen some very fine crops of wheat grown in this way. Before purchasing a machine digger growers should be sure that it is a make of good repute, for there are machines on the market which are far from satisfactory.

It will now be assumed that the crop is ripe, and that the grower is provided with a machine digger. It is most essential to have a careful gang of men to pick up the potatoes behind the machine; one careless picker will spoil the whole sample. I strongly recommend picking into baskets; it is quicker and easier on the men, and the baskets will last for years if stored in a dry shed between seasons. The best sort of basket for the work is a stout wicker one about 2 ft. by 1 ft. 3 in. on top and 1 ft. deep, with a strong handle. For picking up, the men should be placed in stages around the break then being dug. Fast pickers require a longer stage than do slow ones. (It is advisable to pay pickers by the bag.) The table potatoes are picked up first, and then the pickers work back on the stage, picking up the small tubers. A reliable man should be put on to sew the sacks; in fact, this should be the grower's own job, for it is here that faulty pickers can be noted. In this position also one can see that the sacks are well filled. Use



POTATO-DIGGING MACHINE.

The machine is here seen at work in a heavy crop of Gamekeeper at Willowbridge.



REAR VIEW OF DIGGER, SHOWING WORK DONE.

new 46 in. (or wheat) sacks, which, well filled, will weigh on an average 200 lb. This is a suitable weight, and makes a shapely sized sack.

Before filling the sacks they should be branded neatly with the grower's registered brand or any other neat brand. A stencil-plate can easily be cut out of a piece of tin; with this, marking-ink, and a brush one hundred sacks per hour can be neatly branded. Every grower should be proud of his brand, which should be the hall-mark of quality. It is astonishing how quickly the merchants and consumers get to know a reliable brand, and such a brand will soon command the top prices.

I would recommend carting the crop from the field immediately. If the filled sacks are left standing a day or two in the sun the tubers on the sunny side are inclined to green and spoil. Also, if it is late in the season, there is always a danger of frost; a heavy frost will penetrate the sack and injure the tubers. It is a most disagreeable task having to repick potatoes after they have been frosted in the sacks. The grower should not entertain the idea of storing if there has been a frost on the standing sacks, but should sell promptly for early consumption, for it is almost impossible to distinguish every frosted tuber, and those left soon rot and contaminate others.

GRADING.

This is one part of potato-growing to which too little attention is paid, and I think it is quite safe to say that fully 50 per cent. of the consignments forwarded to the markets are of inferior sample. The first grading is done immediately after the machine digger, the table potatoes being picked up first and the seconds next. Growers may be here urged to insist upon their pickers making only A1 grade of table potatoes. See that all doubtful tubers are placed with the seconds; the latter are regraded for seed, and these doubtful table tubers can then be taken out if it is seen on closer examination that they are all right.

There are one or two makes of machine potato-graders on the market, and some of these, if carefully operated, do good quick work, separating table tubers from seed, and seed from pig potatoes, at the one operation. Growers having a large quantity of potatoes to grade may be advised to use the machine, hand grading being slow and tiresome work. In the machine grader the potatoes pass over a travelling apron, and a good operator can hand-pick any deformed or diseased tubers as they pass him.

For hand grading small quantities a good method is to place four sacks on level ground close to the heap, then empty a sack of potatoes on these, and pick the seed or table tubers, drawing back the picked-over potatoes as one progresses. By commencing at the edge of the heap and drawing back refuse one makes sure of going over the lot only once. This method also applies to picking on a floor or table.

STORING.

There are several methods of storing potatoes. The old pit or clamp style is fairly well known, but it is not much in vogue now. However, it is undoubtedly one of the most satisfactory methods; the tubers keep fresher and do not lose weight, and it means a great saving in

sacks. To make a pit chip a level surface about 6 in. deep, $\frac{3}{4}$ ft. wide, and as long as the pit is intended to be, and throw the chipped soil to left and right, forming a bank on each side. For filling the pit cart the sacks from the field and back over the edge of the trench, emptying the sacks and keeping the heap Λ -shaped. Covering of the clamp is done with pulled straw or rushes about 3 in. in thickness, this being followed with 2 in. of soil along the sides and up to 6 in. on the top or cap. Another way of storing, and which is very common in Canterbury, is to make a stage of timber, preferably on the north side of a fence or plantation. The sacks of potatoes are stacked on this, and then covered with straw on both top and sides. This is an excellent method if the grower intends selling before the spring, as it saves rebagging and much time.



POTATO-GRADING MACHINE.

Driven by horse-power; capacity up to 300 sacks per day.

I would strongly advise growers not to store if there are any indications of blight in the crop. In storage, the disease will soon contaminate the bulk lot.

MARKETING.

Marketing is undoubtedly one of the most important sides of commercial potato-growing. The very wide difference between the price often received by the grower and the retail price to the consumer is well known. The growers in the principal producing districts have recently banded themselves together under the South Island Potato-growers' Association, the objects of this organization being "to bring growers and consumers closer together and control distribution." To a certain extent these objects are already being attained, for the

distribution during the past season has shown a great improvement. Closer co-operation between producers and consumers is required, however.

Unless a grower is in a position to take risks he may be strongly advised to sell off the fork or machine, as potatoes are liable to deteriorate quickly. In the case of large growers it is a good plan to sell half the crop as soon as dug and store the remainder. Since the imposing of the Australian embargo commercial potato-growing in New Zealand has become considerably more speculative, the local market being so easily oversupplied.

(To be continued.)

SAND-DUNE RECLAMATION.

ACTIVITIES OF THE STATE FOREST SERVICE.

H. A. GOUDIE, Conservator, State Forest Service.

THE drifting coastal sand-dunes in New Zealand occupy an approximate area of 300,000 acres, which is practically unproductive, and are annually increasing in size and encroaching on valuable agricultural land, causing a grave position in certain coastal regions. The Government, having already recognized that this is a matter calling for State action, has now entrusted activities in connection with the problem to the State Forest Service.

Although the problem of controlling drifting sand has been successfully dealt with in several countries, and there are certain known broad general principles which are universally applicable, it is fairly certain that in each instance there were local conditions which required careful study and observation before success was assured. The character and quality of the sand, the topographical features, the strength and frequency of the winds, and general climatic conditions are some of the matters which require to be observed on the spot, and over a considerable period, before it is possible to proceed with any degree of assurance. The efforts now being made by the State Forest Service are therefore to a considerable extent experimental in character, and are designed to ascertain which is the most efficacious and least costly method to pursue. The wisdom of proceeding cautiously for a start is unquestionable when it is remembered that the work, even under the best conditions, is of a costly nature.

EXPERIMENTAL AREA NEAR RANGITIKEI RIVER MOUTH.

The area chosen for the experimental work is portion of Run No. 24, situated south of the mouth of the Rangitikei River. It extends from the river for a distance of about four miles along the sea-coast, and has an average depth of about one mile. It was selected as being typical of the large area of sand-dunes which extends along this coast from Paekakariki to Patea. The foredune is very irregular, and consists of innumerable small hillocks of sand separated by deep,

narrow wind-channels. This formation extends in from the beach for a distance of perhaps half a mile, except that the sandhills gradually become less numerous, and the sand-hollows between them widen as they recede from the shore. Beyond this the hillocks often merge into low ranges extending in an easterly direction at right angles to the shore and parallel to the prevailing wind. The sea-beach is littered with logs which have been brought down by the rivers in flood-time and cast up during spring tides.

Judging from the large variety of indigenous plants which are found growing on this sand area, one is forced to conclude that prior to the interference of man the sand was in a much more stable condition than it is at present. Indeed, the persistence shown by many species in face of the continuous alteration to the surface of the land is wonderful, and it seems almost certain that once the causes of the destruction of the vegetation are removed nature will assist greatly in repairing the damage which has taken place.

DESTRUCTIVE AGENCIES.

Foremost among the destructive agents are cattle, sheep, and, to some extent, rabbits. This area has been used as a grazing-run for many years past. Heavy cattle have wandered over the sandhills browsing on the native herbage, sometimes uprooting and killing the plants and exposing the sand to the erosive action of the strong winds off the sea. Once a drift is started, an ever-widening wind-channel is formed, and plants are undermined and perish from exposure of their roots, while the moving sand buries others in its course. To have proper effect as a sand-binder the plant covering must be uniform both as regards distribution and height-growth. Isolated patches of even the most effective sand-binding plant are undesirable, because in the course of time small hillocks are formed which divert the wind and cause the scouring-out of hollows or wind-channels, in which it is impossible for plant-life to exist. Thus the destruction by browsing animals of even a small portion of the plant-life opens a way for widespread destruction by another agent—the wind.

The exceedingly irregular nature of the foredune may be attributed to some considerable extent to the destruction of the plant-life by cattle, but here the trouble has undoubtedly been accentuated by the presence of large quantities of drift-wood lying on the beach. Any solid obstacle tends to divert the wind, and obstructions are often of such a nature as to concentrate the force of the wind on to a comparatively small area, with damaging effect.

PAST AND PROPOSED WORK.

In 1916 the writer undertook some experimental work on the Rangitikei area, but owing to labour difficulties at that time it had to be abandoned the following year. The experience gained, however, has not been lost, and much of the work proved so successful that the foredune for the distance of a mile is now even and well fixed with marram-grass and other sand-binding plants. Small experiments made with trees have shown that at least two species—*Pinus densiflora* and *Pinus Thunbergii*—are well suited for sand-planting.

The effort now being made by the Forest Service was commenced early in the current fiscal year primarily as a means of assisting unemployed returned soldiers. The work done, both in the establishment of the camp and in the fixation of the sand, is precursory to a definite scheme of experimental work in sand-dune reclamation. The progress made has been very satisfactory. The area has been enclosed with a cattle-proof fence; about 60 acres have been planted with marram-grass; 250,000 marram sets have been collected and lined out for next year's operations; and a large variety of cuttings and plants has been used experimentally.

In order that the local conditions may be properly understood and the effects of the various methods employed carefully watched, an officer has been detailed to reside on the spot and note and report all matters of interest. The effect of the exclusion of cattle upon the existing plant-growth, the comparative value of various plants as sand-binders, the velocity and prevalence of winds, the comparative effectiveness of different styles of sand-catching fences, and the suitability of various kinds of trees and shrubs for sand-planting are all matters which require constant and careful observation.

During the next few months it is intended to use the labour available upon the improvement of the foredune. Fences constructed with manuka or other material will be erected in the wind-channels in order to cause an accumulation of sand and thus eliminate these undesirable hollows. Some parts of the foredune are very badly broken up, and it will take probably the best part of two years to build up the sand sufficiently to permit of the planting of marram-grass. In the zone immediately behind the foredune it is intended to endeavour to raise the level of some of the sand-hollows, in which rain-water accumulates, by denuding the tops of the adjacent sand-mounds and allowing the wind to break them down. As the source of supply of sand is from the sea, it is considered that the improvement of the foredune is a matter of prime importance. It is not intended, however, to altogether neglect the interior drifts, the more urgent of which will be dealt with during next planting season. The work as a whole is full of interesting problems, the solution of which will provide valuable information for application on similar sand-dune areas either by the State or by private individuals.

TREE-PLANTING THE OBJECTIVE.

The only manner in which the permanent stability of the sand can be secured is by obtaining a close covering of trees. The fixing of the sand by the use of marram-grass or other similar sand-binding plants should be but a preliminary to the more permanent tree covering. For the afforestation of coastal sand-dune areas trees which will succeed in poor sand and thrive in spite of the saline winds are essential. As previously mentioned, *Pinus densiflora* and *Pinus Thunbergii* have both shown that they will thrive under these conditions. The plot in which these species were planted is about three-quarters of a mile from the coast, and while species like *Pinus radiata* (insignis), *Cupressus macrocarpa*, and several acacias were badly browned by the saline winds, the two pines mentioned were not in the least affected. It is intended to make experimental plantings of all likely species over as

wide a range of conditions as possible, in order that a suitable selection may be made when the sand is sufficiently stable to permit of trees being planted. It is thought that a permanent protective belt some chains in width will require to be formed immediately behind the foredune with some hardy pine or a mixture of suitable trees and shrubs. The trees in the outside row of such a belt will naturally become misshapen as the result of exposure to the strong winds off the sea, but they will gradually increase in size towards the interior, and form a breakwind behind which timber-producing species more sensitive to saline winds can be successfully grown.

COST AND RESULTS.

At the present time it is not possible to state what the sand-fixation work will cost; the experiments now under way are designed to solve that question. The cost of fixing the sand on a drift may possibly be as much as £25 per acre, but it should be borne in mind that the fixation of the main drifts will afford protection to large adjacent areas and allow the plant covering to become re-established by natural means. The cost, therefore, when spread over the whole area influenced by the work done will bring the average expenditure per acre very much below this figure. The cost of reclamation might reasonably be regarded as a charge upon the valuable agricultural land which the reclamation work is designed to protect, and not against any tree-planting which subsequently may be done to give permanence to such reclamation. If the expenditure is regarded in this light there can be no doubt that the forest crop which the sand-dunes are capable of growing will be a payable one. This is especially true of the dunes on the west coast of Wellington, adjacent to which are large areas of long-settled farm lands and convenient railway facilities for marketing the crop of timber.

The fixation of the sand and prevention of further invasion upon valuable agricultural land, the use of these (at present) unproductive areas in growing crops of timber, and the improved climatic conditions which the plantations will produce when well established recommend this reclamation as a work of both local and national importance.

Importation of Plants into Australia.—Owing to the existence in New Zealand of fireblight, the Government of the Commonwealth of Australia has issued an order prohibiting the importation into that country from New Zealand of all plants and parts of plants (including fruit); provided that agricultural, grass, vegetable, and flower seeds may be imported, subject to the exception of the seeds of any plant of the family Rosaceae and the seeds of any fruit-tree.

The Farm Separator.—The Acting Director of the Dairy Division makes the following remarks in his last annual report: "The farm separator is usually found in a cleaner condition than is the milking-machine. It is suggested that dairy-farmers recognize fairly fully that their supply of butterfat is likely to be reduced if separators are not kept in proper order. Too often, however, the separator is installed in the same room as the engine and vacuum-pump. A separate room is a necessity. It has also been found that too frequently separators are disposed of as unsatisfactory when a few shillings spent on repairs is all that is required. The advice of our officers has effected a considerable saving to dairy-farmers in this respect."

IRRIGATION IN CENTRAL OTAGO.

BORDER-METHOD TRIAL AT GALLOWAY EXPERIMENTAL AREA.

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J. R. MARKS, A.M.I.C.E., M.N.Z.Soc.C.E., Resident Engineer,
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FOR the information of readers unacquainted with the climatic and physiographical conditions of Central Otago it may be stated that this district is situated well inland and slightly north of Dunedin, and that on account of the low annual rainfall of less than 14 in. which obtains there it must be looked upon as a semi-arid region. In consequence of this low rainfall, most of which occurs during the winter months, and of the high temperatures which prevail during the summer, crop-production is at best a precarious undertaking unless resort is made to irrigation. In Central Otago there are thousands of acres of very fertile land which, though at present in a barren and unproductive condition, will respond marvellously to the application of water, and so produce some of the finest crops in the Dominion. This district in consequence must be looked upon as one requiring intensive irrigation before crop-production can be assured, and accordingly most of the settlers depend upon the application of water to assist their growing crops in attaining full maturity.

Several Government irrigation-works and numerous smaller private ones have been established in various parts of Central Otago, and it is from such sources that the settler obtains water for irrigation purposes. In the initial stages of such schemes, and pending closer settlement of the lands, the demand for water was not excessive, and abundance to meet the full requirements of every settler supplied by the scheme could be given. Unfortunately, as is the case in practically every irrigation project, much of this water was wasted, and the methods of applying it to the crops which it was primarily intended to benefit were in many instances so uneconomical and haphazard that the crops suffered in consequence.

The Department of Agriculture, in co-operation with the Public Works Department, realizing the necessity of showing the settler how best and most economically his water-supply might be used, has accordingly commenced operations on an area of land of approximately 140 acres situated at Galloway, some three miles north-east of Alexandra. It is intended to conduct experiments and demonstrations by which it is anticipated that important data bearing on irrigation practices will be collected, and that the various methods of irrigation applicable to the different types of land will be actually demonstrated. The soil on this land is of a mica-schist origin, and varies considerably in depth over the whole area. In some parts there is barely an inch of soil covering the free gravel which constitutes the subsoil, and any water poured on this type of land is quickly lost by percolation. The grades vary considerably from steep slopes to comparatively flat

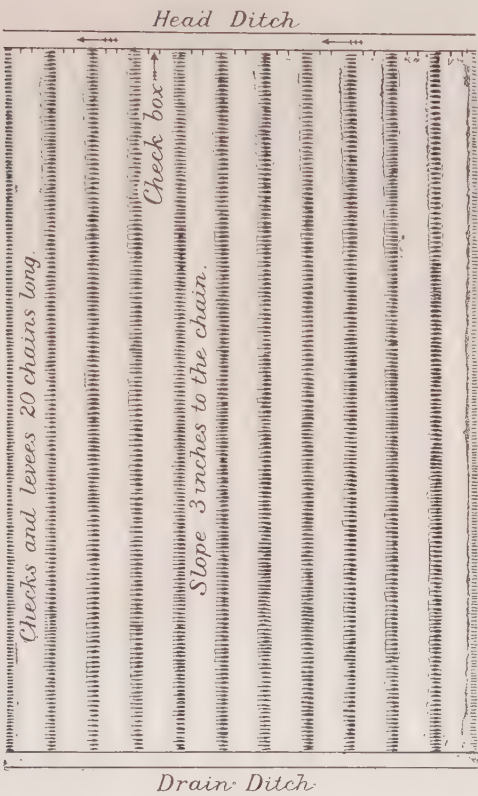


FIG. 1. DIAGRAMMATIC PLAN OF AREA AT GALLOWAY LAID OUT IN BORDER METHOD OF IRRIGATION.

The width between the levees varies according to the check.



FIG. 2. CROSS-SECTION OF LEVEE IN BORDER METHOD.

The dotted line represents the shape of the levee when first formed.

stretches, and from this point of view the area is ideally adapted for demonstrating the mode of applying water to the different grades of land.

THE BORDER METHOD.

The particulars here detailed indicate the information obtained to date on the Galloway area as the result of a series of experiments, conducted by the writers, in irrigating by what is generally called the border method. This method, which lends itself admirably to the irrigation of lucerne and grain crops, is fairly widely used in different parts of the United States, India, and Australia. It is especially adapted to land with a medium uniform slope or very flat land, and to open light soils that absorb water readily. In this respect it must eventually become one of the most general methods of irrigation in Central Otago, on account of the large areas which can be economically and most advantageously laid out in this way.

Primarily the border method consists in dividing the field into a series of parallel strips or borders by low flat levees, and quickly running a wave of water along each strip between the levees. The stretch of land selected for the purpose of the experiments has a fall of approximately 3 in. per chain, and comprises an area of approximately 16 acres. The soil is of a very light mica-schist with gravel showing through, a type of soil which, as already mentioned, readily soaks up water, and is typical of a large part of Central Otago. Fig. 1 gives an indication of the lay-out. A head ditch, fed from the main irrigation-race, was made across the highest part of the field at right angles to the general fall of the land. This head ditch was of such a size that it could carry 10 cusecs* of water, and the construction was carried out chiefly by the use of a packing-plough and a horse scraper. Borders or levees were next constructed running at right angles to the main ditch, these being formed merely by ploughing three furrows and packing the earth to form a mound. Ordinarily in preparing land for border irrigation the ground is first ploughed and disked, and the location of the levees is marked out by plough-furrows. A good foundation for the levees can then be made by ploughing two or more furrows on each side of the levee-line, the earth being thrown towards the centre from both sides. The actual levees may then be built with a horse-scoop, which is driven back and forth at right angles to the levee-lines, and, in so doing, the land between the levees is automatically graded. It will probably be found that the construction of the levees may be done to a large extent (or almost wholly in some cases) by an intelligent modification of the method of the second ploughing and diskings of the land. The finished height of the levees will require to vary with the slope of the land and the quantity or head of water to be used, and should reduce to nothing at the bottom end of the length being watered. This is in conformity with the wave of water to be confined, which starts with a considerable depth, and in doing its duty of saturating the soil is reduced to nothing at the bottom end of the field. In general it will probably be found that the maximum height required will be 6 in. or 7 in., with a base up to 6 ft. or 8 ft. wide. Fig. 2 illustrates a cross-section of the finished levee, which is really only a slight mound, and

* The term "cusec" denotes a flow of water equivalent to 1 cubic foot per second. It is synonymous with the old mining term a "head" of water.



FIG. 3. GENERAL VIEW OF THE LAND AT GALLOWAY EXPERIMENTAL AREA LAID OUT IN THE BORDER METHOD.



FIG. 4. CLOSER VIEW OF HEAD DITCH, CHECK-BOXES, AND CHECKS



FIG. 5. ONE OF THE CHECK-BOXES BUILT IN BANK OF HEAD DITCH.

not a rampart. This mound will permit of the cutting and raking of hay with comparative ease, and once completed, it remains a permanency, requiring no maintenance.



FIG. 6. SHOWING THE EXTENT OF GROUND IRRIGATED IN CHECK 4 AFTER THE WATER HAD BEEN FLOWING FIFTEEN MINUTES.

The writers, in preparing the land at Galloway, did not use a horse-scoop, the chief object in this trial being to ascertain certain data in regard to the actual quantity of water required and the effect of such water when applied. For experimental purposes the length of the



FIG. 7. WATCHING THE EXPERIMENTS.

A gathering of departmental and local body representatives, settlers, &c., took place on the area.

various "checks" (the strip of land between each levee) was fixed at 20 chains, and the distance between the levees themselves varied from 30 ft. to 70 ft. The head ditch was 10 chains long, and ten checks were formed at right angles to it. A wooden gate was then constructed

for each check, allowing water to flow from the main ditch into each individual check.

The work was completed by contract labour, the following being a summary of costs for the various items: (1) Constructing levees, 8 in. to 4 in. high (eleven levees, 20 chains long), £14 2s. 11d.; (2) constructing head ditch across head of checks, 8 chains long, £15 11s. 4d.; (3) material for ten border gates, £4 9s.; (4) erecting ten gates and small measuring-weir, £6 11s. 10d.: total, £40 15s. 1d. From this it will be seen that the total cost amounted to approximately £2 11s. per acre; but it must be borne in mind that the class of work entailed in the preparation of the land for this method of irrigation can be entirely done by the farmer himself at a much cheaper rate per acre, and the above naturally represents maximum cost.

In constructing the levees it was endeavoured to so form them that the height at the end nearest the head ditch would be approximately 8 in., tapering gradually to 4 in. at the extreme end, where it was anticipated the volume or stream of water would be smaller, and consequently the depth less than that at the upper end near the border gate.

One of the chief difficulties met with in irrigation is that of quickly covering the ground with the requisite amount of water in a complete and even manner. The common method of irrigation adopted throughout Central Otago is by what is known as the "wild-flooding" system, favoured no doubt on account of the low initial cost of preparation of the land. But although such initial cost is considerably less than that of any of the other methods of irrigation, this is more than offset by the increased cost of handling the water on the ground, in that it requires more attention and more leading around with the shovel in order to cover all the surface, and must be changed at frequent intervals. Moreover, the wild-flooding method cannot be looked upon as an economical practice, as the water, not being confined in regular paths, either concentrates to the hollows, or by endeavouring to spread too freely loses its velocity and soaks down and through the subsoil before it has travelled over a reasonable area of the surface.

By the border method these disadvantages are overcome. Water is admitted to each check through a gate or box placed in the bank of the head ditch. The exact volume of water depends entirely upon the width and length of the check, the fall of the land, and the nature and porosity of the soil. Water after being admitted passes fairly rapidly over the check in a thin sheet or wave, and before it reaches the lower end of the field the check-gate is closed, as there is then usually sufficient water flowing in the check to complete the irrigation. A drainage ditch is usually provided at the lower end of the checks to carry off surplus water. Theoretically this surplus water should be nil, if it were possible to so carefully regulate the supply, but the drain is recommended as a precautionary measure.

THE EXPERIMENTS.

The writers, in searching for definite information regarding the width of checks, length of checks, quantity of water to be used, and such important data, found that most of the available literature on the subject was of such an indefinite and general nature as to be almost valueless, and accordingly it was thought best to ascertain these important factors by initiating a series of experiments. The following

data give an indication of the lines along which the experiments were conducted, and record some of the results obtained therefrom.

Check No. 4.—This check was 20 chains long and 50 ft. wide. It was decided to irrigate this particular check with 3·8 cusecs of water, and the following notes were recorded:—

Distance from Top End.	Time Water first reached this Point.	Time Maximum Flow reached this Point.	Depth of Maximum Flow at this Point.	Time Surface Water had disappeared at this Point.	Depth of Saturation on Completion.
Chains.	Min. sec.	Min. sec.	In.	Min.	
0	..	..	2	59	} Over 18 in.
1	2 30	4 0	2	64	
2	5 30	7 45	1	65	
3	7 20	9 20	1	66	
4	10 20	12 15	1	74	
5	15 0	22 25	1	76	
6	21 0	25 30	1	77	
7	28 0	37 0	1	77	
8	37 0	52 0	$\frac{1}{2}$	77	
9	52 0	65 0	$\frac{1}{2}$	77	
10	63 0	65 0	..	77	

NOTE.—No data as to percentage of saturation after irrigation.

The water was turned on for fifty-nine minutes and then shut off. The extreme length irrigated in the check was a distance of 10 chains, so that the total acreage was 0·75 acres. Summary: Width, 50 ft.; length, 10 chains; area of whole length irrigated, 0·75 acres or 33,000 sq. ft.; quantity of water used, 3·80 cusecs or 13,452 cub. ft.; time water turned on, 59 minutes; quantity of water used in depth over area, 4·88 in.; rate of irrigation, 78·67 minutes per acre.

Check No. 3.—In this check, which was also 50 ft. wide, it was decided to note the result of irrigating with a larger volume of water, and accordingly 6·4 cusecs were used. The results were tabulated as follows:—

Distance from Top End.	Time Water first reached this Point.	Time Maximum Flow reached this Point.	Depth of Maximum Flow at this Point.	Time Surface Water had disappeared at this Point.	Depth of Saturation on Completion.
Chains.	Min. sec.	Min. sec.	In.	Min.	
0	..	..	3 $\frac{1}{2}$	40	} Over 18 in.
1	1 30	2 45	3 $\frac{3}{4}$	53	
2	2 30	4 30	2 $\frac{3}{4}$	57	
3	4 30	6 30	2 $\frac{3}{4}$	59	
4	7 0	9 45	2	61	
5	10 30	13 45	2	81	
6	15 30	17 50	1 $\frac{3}{4}$	81	
7	21 15	24 45	1 $\frac{1}{2}$	81	
8	28 30	31 30	1 $\frac{1}{4}$	81	
9	31 30	35 40	1 $\frac{1}{4}$	81	
10	36 30	39 50	1 $\frac{1}{2}$	81	
11	41 30	45 40	$\frac{3}{4}$	81	
12	47 40	51 30	$\frac{1}{4}$	81	

NOTE.—No data as to percentage of saturation after irrigation.

In this case better results were obtained, in that the area irrigated was larger and the period of time shorter, the water being turned on for forty minutes.

Summary: Width, 50 ft.; length, 12 chains; area of the whole length irrigated, 0.90 acres or 39,600 sq. ft.; quantity of water used, 6.4 cusecs or 15,360 cub. ft.; time water turned on, 40 minutes; quantity of water used in depth over area, 4.60 in.; rate of irrigation, 44.44 minutes per acre.

The use of a larger volume of water in this case was of decided advantage, and it was accordingly decided to irrigate a narrow check with a large head of water to note the effect.

Check No. 10.—This check was 30 ft. wide and 20 chains long. A volume of water of 7 cusecs was turned on for twenty-six minutes, and the data collected were as follows:—

Distance from Top End.	Time Water first reached this Point.	Time Maximum Flow reached this Point.	Depth of Maximum Flow at this Point.	Time Surface Water had disappeared at this Point.	Depth of Saturation on Completion.
Chains.	Min. sec.	Min. sec.	In.	Min. sec.	
0	..	..	4	26 0	} Over 18 in.
1	0 33	1 15	2½	27 0	
2	1 25	2 0	3½	30 30	
3	2 35	3 15	3½	35 30	
4	3 50	4 30	3	39 30	
5	5 0	6 0	4	40 30	
6	6 15	7 20	3	41 30	
7	7 40	8 45	3½	44 30	
8	9 10	10 25	3½	44 30	
9	10 55	12 30	2½	44 30	
10	12 30	13 40	3	46 30	
11	14 15	15 20	3	48 0	
12	16 20	17 40	3½	49 30	
13	18 25	19 50	1½	53 30	
14	19 50	21 40	2	55 30	
15	21 30	23 15	3	59 30	
16	24 15	25 30	4½	61 30	
17	26 0	27 0	4½	64 30	
18	28 10	29 30	2½	64 30	
19	30 0	32 0	1½	64 30	
20	31 0	32 20	6	64 30	

NOTE.—No data as to percentage of saturation after irrigation.

There can be no doubt that this check was too narrow, and the volume of water used too large. A quantity of water ran out at the end of the check, and it was computed that an additional 3 chains could have been irrigated. Summary: Width, 30 ft.; length, 20 chains; area of whole length irrigated, 0.9 acres or 39,600 sq. ft.; quantity of water used, 7 cusecs or 10,920 cub. ft.; time water was turned on, 26 minutes; quantity of water used in depth over area, 3.3 in.; rate of irrigation, 28.88 minutes per acre.

Other checks of varying widths were irrigated with different volumes of water, and, without going into full particulars, the following table summarizes the whole of the results:—

—	No. 10.	No. 4.	No. 3.	No. 5.	No. 6.	No. 2.
Length of check (chains)	20	10	12	8	12	10
Width of check (feet)	30	50	50	40	60	50
Percentage of saturation before irrigation	12·4	12·4	12·4	12·4	12·4	12·4
Percentage of saturation after irrigation	No data	No data	No data	18·4	21·8	23·22
Depth of saturation (inches)	Over 18	Over 18	Over 18	Over 18	Over 18	Over 18
Water used (cusecs)	7	3·80	6·4	2·5	7	5·8
Depth of irrigation (inches)	3·3	4·88	4·06	5·03	2·65	4·55
Area irrigated (acres)	0·90	0·75	0·90	0·48	1·09	0·75
Time of irrigation (minutes)	26	59	40	59	27	36
Rate of irrigation (minutes per acre)	28·88	78·67	44·44	122·91	24·77	48

CONCLUSION.

One of the most important features demonstrated during the course of the experiments was the rapidity and completeness with which the land could be irrigated, and the economical manner in which every drop of water could be utilized. The trend of the experiments goes to show that a large supply of water for a short period is of much greater value than a small supply for a lengthy period. The greatest waste in irrigation comes from dribbling through farm laterals and over parched fields streams too small to accomplish much more than moisten the bare surface or equal the rapid evaporation that occurs under usual field conditions. Heavy unavoidable losses attend attempts to supply all portions of land at the same time. The use of large heads run for only a portion of time on one section does away with losses, lessens the time and help necessary, and gives far better results to the farmer.

Although sufficient data have not yet been collected by the writers to dogmatize upon, indication has been given by this series of experiments that checks in the vicinity of 50 ft. wide by 10 chains long will be the most suitable for Central Otago conditions when from 4 to 5 cusecs can be obtained for irrigation purposes. However, further information on these points will have to be ascertained, and in due course definite data in regard to the most economical method of laying out land on the border method will thus be established for the guidance of irrigators utilizing this method of water application.

Lime and Agriculture.—During the year ended 31st March last 102,010 tons of limestone were quarried in the Dominion for agricultural purposes.

THE SOUTHERN-BEECH (NOTHOFAGUS) FORESTS OF NEW ZEALAND.

THEIR ECONOMIC SIGNIFICANCE.

ON 30th September last Dr. L. Cockayne, F.R.S., delivered an important and interesting address before the Wellington Philosophical Society on the southern-beech forests of this country, in the course of which he announced a remarkable discovery he had recently made which sheds a new light upon the composition of these forests and their value for the production of timber. The following abstract of the lecture has, at the request of the Editor, been prepared for the *Journal* by the lecturer, who has taken the opportunity of adding some related matter not specially dealt with in the lecture itself.

ABSTRACT OF LECTURE ON THE SOUTHERN-BEECH FORESTS.

The southern-beech forests of New Zealand, hitherto almost neglected, if not despised, are undoubtedly second to none amongst the natural forests of this Dominion. They are, indeed, a splendid asset, full of potential wealth. The value of these great tree-communities lies not merely in the vast amount of timber which they contain (the poorest of which can be used for the production of spirit and pulp), but in the following characteristics so essential in forest areas to be set aside for the continuous production of timber: (1) The southern-beech forests usually grow on soil and in situations where their conversion into grassland is so difficult and uncertain that their most payable utilization is their retention as forest reserves; (2) they form a class distinct from the ordinary New Zealand bush, and for forestry purposes can be dealt with by methods approximating to the orthodox lines of forestry as developed, practised, and taught in Europe; (3) they regenerate with fair rapidity, either after felling, burning, or natural death, into forest almost identical with the original; (4) in such regeneration there is no succession of different tree or shrub associations, but the southern-beech comes in pure from the beginning, with the saplings so close together as to ensure commercial timber of the best quality.

CLASSIFICATION OF THE NEW ZEALAND FORESTS.

In New Zealand there are three distinct classes of forests—namely, rain forest, swamp forest, and southern-beech forest.

Rain forest usually occupies soil of good quality. Its presence does not depend upon the amount of water in the ground, but upon there being a sufficient number of rainy days evenly distributed throughout the year. It is closely related to moist tropical forest, and so differs altogether from the forests of temperate Europe, Asia, or North America. It has a complicated life-history, and passes through a series of stages, extending over many years, before its final composition as a milling-forest is attained. Its trees and shrubs are

nearly all evergreen, and consist of many species. Usually there is an extremely dense undergrowth in which tree-ferns and smaller ferns play an important part. Woody rope-like climbing-plants and perching-plants of great size are a striking feature. There are various kinds of rain forest, but these fall into one or other of the three classes—taxad forest,* where rimu, matai, or totara may be dominant; kauri forest, where kauri may be either the principal tree, or be dotted here and there or in small groups; and forest composed of broad-leaved dicotylous† trees, with the taxads few or absent. Coastal forest is modified rain forest, but it is generally of little importance for forestry, though some occupies land of high quality for pasture.



FIG. 1. VIEW SHOWING YOUNG SOUTHERN-BEECHES FROM WHICH THE FIRST HYBRID SPECIMENS WERE COLLECTED BY DR. COCKAYNE.

The line of young beeches is seen in the centre of the photo. Southern-beech forest between Elfin Bay and Rere Lake, Wakatipu. [Photo, W. D. Reid.

The term swamp forest speaks for itself; it is closely related to rain forest so far as its species go, but the kahikatea (*Podocarpus dactyloides*) is easily its most important tall tree. It usually occupies land capable of growing pasture of the highest class.

Southern-beech forest has for its tall trees one or more of the species of *Nothofagus*. It can tolerate considerably drier stations and much poorer soil than can rain forest. Compared with the 400 species of

* This is a more correct term than "pine forest," since the New Zealand conifers are related to the yew (*Taxus*) and not to the pines (*Pinus*).

† Plants where the seedlings have in the first place two seed-leaves, as opposed to those which have only one seed-leaf (monocotylous).

rain forest (for the whole of New Zealand),* those of southern-beech forest are few in number. The undergrowth is far more open; sometimes, indeed, there may be little except the young southern-beeches themselves. In short, for forestry purposes it is much "cleaner" than any kind of rain forest with the exception of pure kauri forest.†

The Species of Southern-beech (Nothofagus).

The name "southern-beech" was coined by Dr. Cockayne some years ago in order to distinguish the beeches of the Southern Hemisphere from these of the Northern Hemisphere, since the

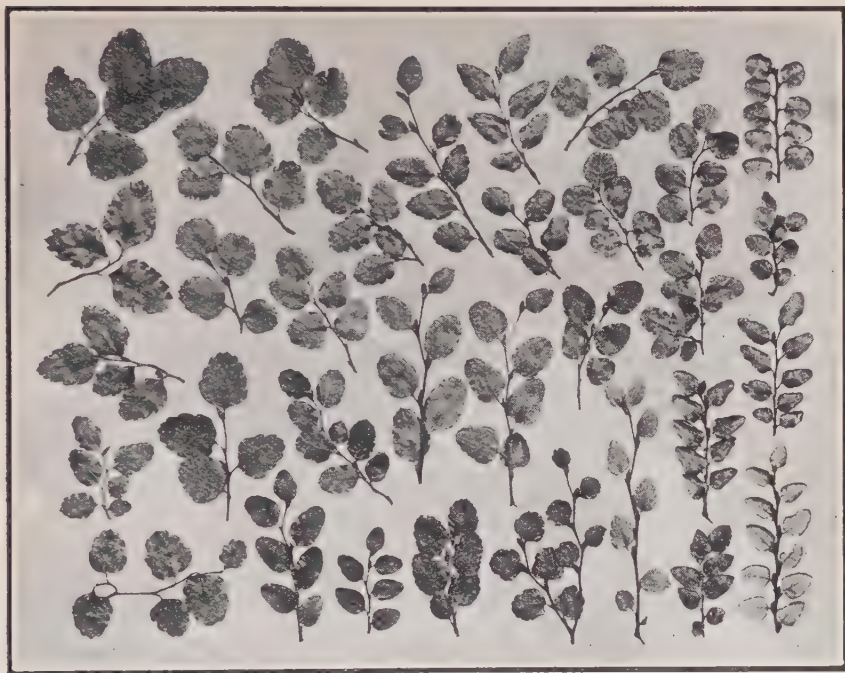


FIG. 2. SOME OF THE HYBRID FORMS BETWEEN THE RED SOUTHERN-BEECH AND THE MOUNTAIN SOUTHERN-BEECH, COLLECTED FROM THE YOUNG TREES SHOWN IN FIG. 1.

[Photo, E. B. Levy.]

former belong to the genus *Nothofagus* (false beech) and the latter to *Fagus* (true beech). *Nothofagus* is limited in its distribution to the southern part of temperate Andean South America (including Tierra del Fuego), New Zealand, Tasmania, and south-eastern Australia. Fossil *Nothofagus* has been found in Antarctica along with other trees of the Tertiary period.

* The rain forest of the North Island, together with the northern portion of the South Island up to about latitude 42° south, is far richer in species than that of the remainder of the South Island.

† Kauri forest may, however, be of extreme density, especially where the kauris stand singly or in clumps.

Up to the present every New Zealand botanist has felt on safe ground when dealing with the classification of *Nothofagus*. Thus six distinct species are recognized—namely, red southern-beech (*N. fusca*), silver southern-beech (*N. Menziesii*), black southern-beech (*N. Solandri*), mountain southern-beech (*N. cliffortioides*), and two rare species, *N. Blairii* and *N. apiculata*. But recent investigations of the lecturer have clearly shown that there are many trees possessing well-marked characters which forbid them falling into the existing classification, so that certain of the southern-beech forests are not composed of one or more of the above species, but are an unknown mixture of trees, the economic value of which is at present undetermined. These anomalous trees were discovered first of all where the forest has been burnt between Elfin Bay (Lake Wakatipu) and Rere Lake (see Fig. 1), but since then numerous specimens, deviating greatly from the recognized types, have been collected by the forest rangers and others in many parts of the North and South Islands.

The theory put forward to account for the origin of these unexpected and unusual forms is that they are crosses between the red southern-beech (*N. fusca*) and the mountain southern-beech (*N. cliffortioides*), or the black southern-beech (*N. Solandri*), as the case may be. These crosses must in certain cases not be first crosses between two species, but have come from crosses between hybrids and a species, between hybrids themselves, and also from self-fertilized hybrids. In a good many forests within an area of a few square chains a dozen or more distinct hybrid trees are growing. But the greatest variety—and this follows from the hybrid theory—is where there is abundance of young plants, as near Elfin Bay (see Fig. 1). Evidently, where the differences are excessive, such young trees must have originated from seed from hybrid trees, as mentioned already, which, as is customary with such seeds, will not be true to type, but will produce numerous plants differing in many particulars both from the parent and from one another.

The various species of southern-beech are classified for the most part according to the characters of the leaf (e.g., shape, base, apex, margin, texture, veins, hairiness, and colour). In the hybrids the leaves exhibit every degree of transition between the parents. For instance, the leaf of *N. fusca* has a strongly toothed margin, while the leaves of *N. cliffortioides* and *N. Solandri*—two species much alike—are not toothed at all. But in the hybrids the leaves show every degree of toothing, from margins quite entire to such as are toothed throughout (see Fig. 2), while some bear only one or two quite obscure teeth near the apex, or the margin may be shallowly indented or waved. So, too, there is every degree of difference in shape, size, hairiness, texture, and form of the apex or the base. So great are the differences in some of the hybrids from any of the known species that any botanist, ignorant of the conditions under which they occur in nature, would unhesitatingly describe them as new species.

Among the hybrids are many forms [more or less resembling *N. Blairii* or *N. apiculata*; indeed, it seems certain that these must no longer be considered species, but groups of hybrids, the type of the so-called species being merely one particular hybrid. There will then be among the hybrids the *apiculata* and *Blairii* groups, but these must

each be subdivided into a toothed and an untoothed series. Then there is an unexpected group of hybrids with small, thick, almost circular leaves margined with broad, rounded teeth, and another group after the manner of *N. fusca*, but with a rather narrow, sharply toothed, thin leaf greatly tapering towards both extremities. But the number of hybrid forms is very great, and some stand quite alone. Of adults more than seventy distinct trees have already been noted, and of saplings and seedlings far more. As for the latter, they exhibit the hybrid characters when quite small—a most important fact with regard to future experimental work.

But the hybrid theory does not explain everything, for the species themselves and their few named varieties are not the distinct entities they are thought to be. The more the matter is studied the more plain does it appear that there are a number of distinct races of the red southern-beech, each of which should be of different value as timber. So, too, with the other species, there is probably more than one true-breeding race of each. In this regard the State Forest Service is rendering Dr. Cockayne great assistance, in that the forest rangers are collecting specimens from all over the Dominion and forwarding them to him. Mr. R. M. Laing, B.Sc., has also given generous aid. It is from these sources, indeed, that the idea of these true-breeding races has been suggested.

DISTRIBUTION OF THE SOUTHERN-BEECH FORESTS.

There are no southern-beech forests north of the Thames Mountains, where the silver southern-beech is first met with, but the red southern-beech occurs sparingly—perhaps only a few trees in any one place—in various localities as far north as Kaitaia. In the East Cape botanical district the black and mountain southern-beeches first appear, and thence pure southern-beech forests extend, but by no means continuously, along the dividing-range of the North Island and the Volcanic Plateau to Cook Strait. This they have crossed—or, rather, there might have been no strait when their journeyings commenced—and great forests extend up to 4,000 ft. altitude along the wetter mountains of Marlborough, Nelson, Canterbury, Otago, and Southland, in some places reaching sea-level. In Westland there are no southern-beech forests from south of the River Taramakau to Paringa, their place being occupied by taxad rain forest with thin-bark totara and kawaka. There are no southern-beeches in Stewart Island or the New Zealand subantarctic islands. In some of the forests the different species occupy large unmixed areas; in others they are intermingled, and there is also a good deal of mixed southern-beech and rain forest on the west of the South Island. With one or two exceptions it is only where the species occur in close proximity that southern-beech hybrids have been noted. But such exceptions are of no moment, for these hybrid trees, many hundreds of years old, first saw the light in forests of different composition, and the parent trees will have died long ago. Of such changes in existing forests New Zealand can supply abundant evidence. As for their vertical distribution, *N. cliffortioides* reaches the highest altitude; then, descending, come *N. Menziesii*, *N. fusca*, and *N. Solandri*, the last being strictly a lowland and lower-mountain species.

REGENERATION.

A matter of supreme importance in forestry is that of a forest regenerating after it is destroyed, or of the manner in which the blanks are filled up after trees have been removed. In both these cases southern-beech forest behaves quite differently from rain forest, and in a manner eminently satisfactory from the standpoint of the forester. Thus it does not commence its regeneration, as does rain forest, by a new plant-association of shrubs or small trees worthless as timber—e.g., wineberry (*Aristotelia racemosa*) or, fuchsia (*Fuchsia excorticata*)—but the southern-beeches themselves appear as if by magic in their thousands, it may be, as soon as a sufficiency of light



FIG. 3. SHOWING YOUNG PLANTS OF SOUTHERN-BEECH GRADUALLY INCREASING IN SIZE FROM LEFT TO RIGHT OF THE PHOTOGRAPH IN ACCORDANCE WITH THE GRADUAL INCREASE OF LIGHT. FOREST BETWEEN ELFIN BAY AND RERE LAKE.

[Photo, W. D. Reid.

is let into the forest. Such seedlings rapidly grow into saplings and may form impenetrable thickets, but eventually the struggle for existence reduces their numbers and the trees have space for their full development. The result of gradual change in the degree of illumination is plainly visible where seedlings arise under the shade of a spreading leafy branch extending outwards into the open. Then, though all the young trees are of the same age, there is a gradual, level increase of height as the light increases (see Fig. 3).

After the forest is felled, or the trees have fallen through natural decay, regeneration by the southern-beech itself is both rapid and

certain. After the forest is burnt, on the contrary, the amount of regeneration depends entirely on the degree to which the humus of the forest-floor has been destroyed. With complete destruction there will be no regeneration except near standing trees, while elsewhere bracken-fern, thickets of shrubs, or, in dry hilly habitats, tussock-grassland, will replace the original forest. Occupying, as it so frequently does, land valueless for agriculture, the rapidity of regeneration is less a matter of economic moment than is its certainty, together with the close growth of the young trees (see Figs. 1 and 3), all of which comes about without any expenditure of money. In other words, the forest will, in large measure, look after itself. The main drawback is the ease with which green *Nothofagus* forest can be burnt as compared with green rain forest.

The "natural decay," already mentioned, may be the result of the attack of fungi, of which a certain species of shelf-fungus, which stands out like a bracket from the tree-trunk, is sometimes strongly in evidence. It seems probable that the durability of southern-beech timber depends largely upon whether the trees are free from fungoid attack. Possibly much of the conflicting evidence regarding the durability of red southern-beech railway-sleepers may be thus explained.

Like many New Zealand forest-trees, the southern-beeches are surface rooters, and so are readily blown down. This especially affects the upland forests of the mountain southern-beech, where extensive destruction appears due to this cause. But in such a case rapid regeneration is certain.

VALUE OF SOUTHERN-BEECH FOREST APART FROM TIMBER-PRODUCTION.

The importance of the extensive southern-beech forests, which cover with a dark mantle so wide an area in the mountains of both Islands, as a protection against erosion and as conserving and regulating the water-supply can hardly be overestimated. Everywhere in the mountains the disastrous effect of destroying the forest covering is plainly to be seen. The effect of erosion after the forest is burnt reaches its maximum where the rainfall is lowest. Thus it can be specially observed to the east of the divide in the South Island. For example, the Percival River at Hanmer, since the forest was destroyed near its source, has brought down enormous quantities of stony debris and raised its bed greatly, burying good pasture on its old flood-plain. Nor can these eastern forests be readily reinstated when in competition with the surrounding vegetation, since they occur under the minimum of conditions suitable for their well-being.

The value of southern-beech forest for scenic purposes must not be lost sight of, since it puts its own peculiar stamp on the landscape. Much of the finest scenery in New Zealand is dependent on the preservation of the forest covering. The Buller Gorge, the scenery of Te Anau and Manapouri, the Matukituki Valley at Wanaka, the lovely Routeburn Valley, and Lake Waikaremoana, supply a few examples out of many. Forests of red southern-beech are especially beautiful; it is to the abundance of this tree that the celebrated drive along the shore of Diamond Lake to Paradise owes its peculiar charm.

CONCLUDING REMARKS.

It is interesting to consider what this new knowledge—yet in its infancy—regarding the classification of the southern-beeches means. By the bushman all are called “birch.”* This matters little, but when among the different “birches” there is no uniformity in their popular names, but, on the contrary, the utmost confusion, it is clear there can be no certainty as to the value, or even the names, of the different timbers. “Red-birch,” “black-birch,” “brown-birch,” and “white-birch” are names of quite different significance in different parts of New Zealand; in one district, for example, one species is called by all these names, while what is “black-birch” in one place is “red-birch” in another, and so on. Nor, as has been shown, are the botanical names—supposed to be definite—much better; all the names, indeed, both popular and scientific, of these important timber-trees are from the practical standpoint quite misleading. Clearly this state of affairs cannot be allowed to remain; an unexplored domain stands ready for new economic exploration, in which field observations, laboratory methods, cultural experiments, and testing of timber must all play a part. It is of prime moment to find out the distribution and percentage of the hybrids in the various forest areas. They may be widely distributed in the forests, or they may be confined to quite narrow limits, and so be but of slight moment. Or, again, it might be feasible to introduce the red southern-beech (*Nothofagus fusca*) into the forests of mountain southern-beech (*N. cliffortioides*) in the hope of these regenerating into higher-class timber.

Even more important than the study of the hybrids is that of the supposed true-breeding races of the so-called “species.” These races may well be expected to be widespread and to form pure stands. Certainly they may also be expected to differ considerably in the value of their timber. Broad hints of such differences have been in the air for many years, but there has usually been nothing definite to go upon, while botanist and bushman have kept too far apart. This, assuredly, should not be; the close collaboration of the two is essential for economic progress.

Apart from a proper and usable knowledge of the species, races, and hybrids of the southern-beech, the forests themselves demand extended study with the economic aspect as the goal. Nothing accurate is known regarding their life-histories—that essential knowledge for progress; the all-important question of regeneration in relation to climate, soil, altitude, milling, fire, and natural death must be thoroughly investigated. The matter of fungoid attack cannot be neglected. In short, the more that can be learnt about these great sources of potential wealth the more rationally can they be treated, and the more profit should such vast tree-communities yield for the benefit of the people.

* Birch does not occur wild in New Zealand; it belongs to the genus *Betula*. The silver-birch so much planted as an ornamental tree is *B. alba*.

Rape for Poultry.—Rape may be fed to poultry of practically any age with beneficial results.

SUGAR-BEET TRIALS AND ANALYSES.

B. C. ASTON, F.I.C., F.N.Z.Inst., Chemist to the Department.

DURING the season 1920-21 further trials in the growing of sugar-beets were carried out at various experimental areas and co-operative plots. The following table gives the results of the analysis of sample roots at the Chemical Laboratory:—

Laboratory No.	Variety.	Where grown.	Dry Matter.	Sugar.	Purity Coefficient.	Average Weight of Roots.
			Per Cent.	Per Cent.	Per Cent.	lb. oz.
O/374	Wanzelban New Crop	Christchurch ..	23.7	14.73	85.3	2 7
O/376	"	" ..	21.6	14.84	87.4	3 9
			22.2	14.80		2 6
			22.3	14.78		1 7
O/379	"	" ..	23.1	15.37	88.0	3 4
			22.8	15.28		2 7
			22.9	15.32		1 2
O/203	Vilmorin's Green-top Improved Brabant	Marton Experimental Area	23.9	13.82	87.5	1 13
O/204	Vilmorin's White Red-top ..	Ditto ..	23.3	14.36	79.3	1 9
O/205	Vilmorin's Improved Selection No. 1 ..	" ..	27.4	16.02	88.3	1 4
O/206	Vilmorin's Improved Selection No. 2 ..	" ..	27.9	15.73	87.1	1 1
O/207	Klein's Wanzelban	" ..	25.5	14.37	87.8	1 4
O/264	Vilmorin's Green-top Improved Brabant	Waimate West Demonstration Area	23.4	14.30	88.0	3 11
O/265	Vilmorin's White Red-top ..	Ditto ..	22.8	14.62	81.2	3 8
O/266	Vilmorin's Improved Selection A ..	" ..	26.8	15.85	87.8	2 14
O/267	Vilmorin's Improved Selection B ..	" ..	25.4	16.17	86.8	2 10
O/264A	Vilmorin's Green-top Improved Brabant	Stratford Model Dairy Farm	23.7	14.08	87.7	3 14
O/265A	Vilmorin's White Red-top ..	Ditto ..	23.2	13.44	81.4	3 10
O/266A	Vilmorin's Improved Selection A ..	" ..	27.0	15.73	88.0	3 2
O/267A	Vilmorin's Improved Selection B ..	" ..	27.3	16.01	86.8	3 0
O/398*	Vilmorin's Improved	Albany Experimental Area	26.7	14.62	86.0	2 2
O/399†	Not stated	Paeroa ..	23.8	15.15	83.8	2 12

* Only five roots analysed.

† Four roots analysed.

Taking the weight of roots yielded per acre with the percentage of sugar shown in the table of analyses, the respective yields of sugar per acre work out as follows: Christchurch—O/374, 2 tons 13 cwt.; O/376, 3 tons 7 cwt.; O/379, 1 ton 16 cwt. Marton—O/203, 1 ton 11 cwt.; O/204, 1 ton 18 cwt.; O/205, 1 ton 9 cwt.; O/206, 1 ton 14 cwt.; O/207, 1 ton 13 cwt. Waimate West—O/264, 4 tons 11 cwt.; O/265, 4 tons 2 cwt.; O/266, 3 tons 3 cwt.; O/267, 3 tons 17 cwt. Stratford—O/264A, 2 tons 5 cwt.; O/265A, 2 tons 6 cwt.; O/266A, 2 tons 3 cwt.; O/267A, 3 tons 2 cwt. Albany—O/398, 1 ton 9 cwt.

NOTES ON THE CROPS.

The following notes have been compiled from particulars furnished by officers of the Agricultural Instruction staff:—

Christchurch.—O/374: Sown in November, 1920; weighed 17th July, 1921. No manure used. Yield of roots per acre, 18 tons. The roots were very badly shaped. O/376: Sown in November, 1920; weighed 25th July, 1921. No manure used. Yield of roots per acre, 22 tons 10 cwt. This sample consisted of rather small well-shaped

roots. O/379: Sown 17th December, 1920; weighed 1st July, 1921. No manure used. Yield of roots per acre, 11 tons 15 cwt. On account of the late arrival of the seed these three crops were sown much too late. Generally speaking, the rows were too far apart (24 in. to 30 in.) to permit of maximum yields, and thinning was not carefully done.

Marton.—O/203-7: Five varieties were tested, each receiving the same treatment. The plots were sown on 16th November with $1\frac{1}{2}$ cwt. superphosphate and $1\frac{1}{2}$ cwt. Ephos phosphate per acre, and the roots lifted on 30th May. The yields of roots were as follows: O/203, 11 tons 2 cwt.; O/204, 13 tons 2 cwt.; O/205, 9 tons 1 cwt.; O/206, 11 tons 12 cwt.; O/207, 11 tons 12 cwt. The season at Marton was too dry for this class of crop, and the land on which it was grown did not prove suitable. Further, the drills were too far apart to permit of a heavy crop.

Waimate West.—O/264-7: Four varieties were grown, similar treatment being given in each case. Plots were sown on 15th November, and weighings made on 7th June. Fertilizer was applied at the rate of 4 cwt. per acre, a mixture consisting of 3 parts of super, 1 part of bone-meal, and 1 part of Ephos phosphate being used. The following yields were recorded: O/264, 31 tons 16 cwt. of roots and 21 tons 4 cwt. of tops; O/265, 27 tons 19 cwt. of roots and 9 tons 3 cwt. of tops; O/266, 19 tons 15 cwt. of roots and 15 tons 2 cwt. of tops; O/267, 23 tons 13 cwt. of roots and 15 tons 18 cwt. of tops. The crops were even, and had been well cared for. Vilmorin's White Red-top (O/265) showed the best-shaped roots. The weather was very dry during the early autumn, and when rain came the tops made tremendous growth.

Stratford.—O/264A-7A: Four varieties, similar to those grown at Waimate West, were tested. All plots were sown on 17th November, a dressing of basic super at the rate of 3 cwt. per acre being given. Crops were weighed on 6th June, with the following results: O/264A, 16 tons 1 cwt. of roots and 6 tons 8 cwt. of tops; O/265A, 17 tons 7 cwt. of roots and 5 tons 2 cwt. of tops; O/266A, 13 tons 14 cwt. of roots and 7 tons 14 cwt. of tops; O/267A, 19 tons 5 cwt. of roots and 11 tons 11 cwt. of tops. In this test also the White Red-top variety produced the best-shaped roots. The yield at this area would have been greater had intercultivation not been neglected.

Albany (Gum Lands).—O/398: Seeding took place on 13th November, and the roots were lifted on 15th June. Fertilizer at the rate of $4\frac{1}{2}$ cwt. per acre, being a mixture of 2 parts of super to 1 part of blood and bonedust, was applied. A yield of 9 tons 16 cwt. of roots was obtained.

GENERAL REMARKS.

The outstanding feature of the foregoing data is the abnormally large yield of beets and tops from the Waimate West (Taranaki) Experimental Area, $31\frac{1}{2}$ tons per acre of roots alone being the estimate, which bids fair to be a record so far for New Zealand beet-growing. In the 1909 annual report of the Department, on page 486, are given results from the Moumahaki Experimental Farm with White Silesian, Vilmorin's Imperial, and Wanzelban varieties, which vary from 26 to 28 tons of roots containing 14 to 16 per cent. of sugar. The country in and around Taranaki would therefore seem to be well suited for the growth of sugar-beet.

LUCERNE EXPERIMENTS AT ASHBURTON.

THE FERTILIZER QUESTION.

F. E. WARD, Instructor in Agriculture, Christchurch.

IN the report on the operations of the Ashburton Experimental Farm for the season 1920-21, published in the *Journal* for September last (page 151), an account was given of the setting-up of an experiment to provide further information regarding certain points in lucerne-culture on which there is a diversity of opinion, as follows: (1) The effect of artificial fertilizers when used as a top-dressing after establishment; (2) the effect of artificial fertilizers sown with the seed; (3) the effect of differential grazing; (4) varying rates of seeding when sowing; (5) the value of thinning a stand intended for seed-production.

The area devoted to the experiment is a 20-acre block divided into 1-acre plots, the sowings being in 7 in., 14 in., and 21 in. rows respectively. The area was sown between 7th and 10th March last, and the first crop was cut for hay early in November.

Interim data on the effect of artificial fertilizers sown with the seed are now available. Unmanured plots were sown alongside plots sown with 2 cwt. of superphosphate per acre, and in order to minimize experimental error the plots were duplicated. The weighings of the first cut are as follows (averages of duplicated plots, green weights): 7 in. rows—unmanured $1\frac{1}{2}$ tons, manured $4\frac{3}{4}$ tons; 14 in. rows—unmanured 2 tons, manured 4 tons; 21 in. rows—unmanured $1\frac{3}{8}$ tons, manured $3\frac{1}{8}$ tons: total—unmanured $5\frac{1}{8}$ tons, manured $12\frac{1}{2}$ tons.

It must be recognized that such results can be regarded only as provisional, as the final effect of manuring might be contrary to the indications given in the case of a first cut. It should, however, be recorded that plants on the manured sections appear much stronger and are deeper rooted than those of the unmanured sections. Owing to the better growth of lucerne and the shade thus afforded the ground was much freer from weeds where fertilizers were applied. Furthermore, the effect of grass-grub attack is less marked in the case of the manured areas, this being no doubt due to many attacked plants being sufficiently strong in their early growth to recover.

It may be mentioned that the intention had been to sow the lucerne on this area in early December (1920), but owing to the presence of yarrow in considerable quantity the seeding was delayed until the first week in March, so that sufficient summer cultivation might be given to get rid of that weed. It is recognized that sowing as late in the autumn as this is not generally advisable, and had a rigorous winter been experienced it is likely that establishment would have been less satisfactory than has been the case. However, the experience of last season seems to indicate that in most parts of Canterbury delaying the sowing until well over the New Year is perhaps better than earlier seeding. Sowing, say, at the end of

January or early February, following fairly continuous summer cultivation, avoids to a large extent the danger of the lucerne being stifled in its early stages by fat-hen and other weeds, which is a serious factor against lucerne-establishment in soils such as the Ashburton ones when sowing is done in November or December.

RAW ROCK PHOSPHATE AND GUM LAND.

T. H. PATTERSON, H.D.A., Instructor in Agriculture, Auckland.

MANURIAL experiments with raw rock phosphate have been in progress for some months at Te Kuiti on light fern land, and some at Pukekohe on volcanic soil, while others are being carried out at Helensville on alluvial flats. In these trials finely ground Nauru phosphate has been used as a top-dressing, and is being tested against well-known fertilizers.

At the Puwera Experimental Area (gum lands) finely ground Makatea phosphate, containing about 83 per cent. tricalcic phosphate, was used with grass-seed sown last March for permanent pasture. The soil is stiff white pipeclay of a common heavy gum-land type, and according to analysis it has been shown that the lime-requirement is 2 tons of carbonate of lime per acre. As it is contended by many eminent authorities that raw rock phosphate is more quickly available in acid soils, and will give better results on such soils than on others where lime is present in adequate quantities, plots one acre in extent were set out in Field 6 (see *Journal* for May last, page 259), as follows: One plot received 3 cwt. of finely ground rock phosphate without any added lime. The adjoining plot, which had been dressed a couple of months before with 10 cwt. of ground limestone, received a similar dressing of finely ground rock phosphate. The third plot received a mixture of finely ground rock phosphate and ground limestone. This mixture, when analysed at the Department's Chemical Laboratory, was found to contain 60.43 per cent. of insoluble phosphate of lime.

The season was favourable for grass, and on the plot that received rock phosphate without any added lime there was a good take of grass. It stood in marked contrast to the adjoining plots on either side of it, which had received lime in addition to the phosphate. On these the take was poor, and for the first couple of months the two limed plots looked bare. After viewing them again (first week of November) the covering of grass had improved, but was still behind the plot which was not limed. The colour of the grass on the limed plots was a much darker green than that on the unlimed plot. Sheep were put on the area, but although watched very closely it was difficult to decide on which plots the grass was the more palatable. It was noticed that the sheep spent most of their time on the unlimed area, but probably this was accounted for simply by the fact that there was more grass there than elsewhere.

While it would be premature to stress the results to date, our experience at Puwera up to the present is bearing out the experience

of investigators in other countries, in so far as concerns giving evidence of the greater solubility of raw rock phosphate on acid soils than on soils where the lime present is considered adequate for cropping



AUTUMN-SOWN GRASS PLOTS AT PUWERA EXPERIMENTAL AREA.

In foreground, plot which received raw phosphate but no added lime, showing good take of grass. In background, plot which received lime and raw phosphate, showing comparative bareness. Photo taken on 9th June, 1921.

purposes. The view seems a reasonable one that acidity in the soil solution would render soluble the otherwise insoluble phosphate rock, while if this acidity was neutralized by lime the phosphate would not be made available so readily for the use of plants.

Winemaking in New Zealand.—It is estimated that the Dominion yield of wine from last season's vintage—which was a good one—was 75,000 gallons. The following are particulars of wines sold from Te Kauwhata Horticultural Station during the last financial year: Frontignac, 5,473 gallons, value £4,651 18s.; Madeira, 1,017 gallons, £876 2s.; Claret, 539 gallons, £377 10s.; Hock, 333 gallons, £242 16s.; unfermented, 20 gallons, £18: total, 7,382 gallons, value £6,166 6s.

Indoor Grape-culture.—The number of vine glasshouses in the Dominion at the close of last official year was approximately 876. Very few were erected during the year owing to the greatly increased cost of labour and materials. The yield of grapes under glass was, generally speaking, very satisfactory, the total crop being estimated at 550,000 lb., which, at 1s. 6d. per pound, has a value of £41,750. A number of returned soldiers have taken up the cultivation of grapes, both outdoor and under glass, this class of work being well suited for partially disabled men.—*Horticulture Division.*

AN APPLE-PACKING READY-RECKONER.

THE accompanying table has been prepared for the purpose of reducing the multiplicity of numbers indicating the size of fruit packed in each case. The actual packing-numbers for the various sizes of fruit are set out, together with the number for each pack which is to be marked on the case. Knowing the number of tiers packed in the case, and by counting the top rows and referring to the chart, a packer will be able to tell at a glance the actual number of fruit contained within the case. The "marking" number for that pack should then be placed on the case.

Apple-packing Table.

Approximate Size.	Pack.	Rows.	Tiers.	Actual Number of Apples.	Marking Number.
In.					
$3\frac{5}{8}$	2 : 2	5 : 5	3	60	64
$3\frac{7}{8}$	2 : 2	4 : 4	4	64	
$3\frac{1}{2}$	2 : 2	5 : 4	4	72	72
$3\frac{3}{8}$	2 : 2	5 : 5	4	80	80
$3\frac{1}{4}$	2 : 2	6 : 5	4	88	88
$3\frac{1}{2}$	3 : 2	5 : 4	4	90	
$3\frac{1}{8}$	2 : 2	6 : 6	4	96	96
3	3 : 2	5 : 5	4	100	100
$2\frac{7}{8}$	3 : 2	6 : 5	4	110	110
$2\frac{7}{8}$	3 : 2	5 : 4	5	113	
$2\frac{3}{4}$	3 : 2	6 : 6	4	120	120
$2\frac{3}{4}$	3 : 2	5 : 5	5	125	
$2\frac{3}{8}$	3 : 2	7 : 6	4	130	130
$2\frac{1}{2}$	3 : 2	6 : 5	5	138	140
$2\frac{5}{8}$	3 : 2	7 : 7	4	140	
$2\frac{5}{8}$	3 : 2	8 : 7	4	150	150
$2\frac{1}{2}$	3 : 2	6 : 6	5	150	
$2\frac{1}{2}$	3 : 2	7 : 6	5	163	163
$2\frac{1}{2}$	3 : 3	6 : 5	5	165	
$2\frac{1}{2}$	3 : 2	7 : 7	5	175	175
$2\frac{1}{2}$	3 : 3	6 : 6	5	180	
$2\frac{3}{8}$	3 : 2	8 : 7	5	188	188
$2\frac{3}{8}$	3 : 3	7 : 6	5	195	200
$2\frac{3}{8}$	3 : 2	8 : 8	5	200	
$2\frac{1}{4}$	3 : 3	7 : 7	5	210	210
$2\frac{1}{4}$	3 : 2	9 : 8	5	213	
$2\frac{1}{4}$	3 : 3	8 : 7	5	225	225
$2\frac{1}{8}$	3 : 3	8 : 8	5	240	240

The method of placing the fruit in the case—on cheek or flat pack—varies, of course, with the different varieties. This must be determined by the packer according to the general requirements of the fruit which is being packed, and cannot be laid down as a definite rule in a table of packing-numbers which is compiled to embrace all varieties.

—*Horticulture Division.*

TESTING OF PUREBRED DAIRY COWS.

NOVEMBER CERTIFICATE-OF-RECORD LIST.

W. M. SINGLETON, Director of the Dairy Division.

THE following lists comprise the records of all cows which have received certificates during the month of November. The Friesian list again includes a performance constituting a new class-leader—Queen Colantha Cadillac, in the senior four-year-olds, with a record of 21,440.3 lb. milk and 803.19 lb. butterfat, replacing Woodcrest Johanna Tehee, with 21,483.1 lb. milk and 754.96 lb. butterfat.

LIST OF RECORDS.

Name of Cow and Class.	Tested by	Age at starting Test.	Fat req'd. for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
JERSEYS.						
<i>Junior Two-year-old.</i>		Yrs. dys	lb.		lb.	lb.
Misnomer's Marmion	B. Hey, Riverlea ..	1 344	240.5	355	8,120.5	520.96
Meadowvale War Baby	E. O'Sullivan and Sons, Tariki	2 0	240.5	365	7,376.6	477.73
Jersey Bank Camelia	A. J. Smith, Cardiff ..	2 0	240.5	365	9,515.1	477.22
Bright Eyes Favourite	L. W. and J. F. Prosser, Leeston	2 27	243.2	365	8,312.5	473.11
Kauket's Girl ..	G. T. Gibbons, Ngaere	1 208	240.5	365	6,728.8	471.63
Jerseydale Merry Maid	J. Pettigrew, Pihama	2 22	242.7	365	8,527.4	470.52
Eaton Melva ..	G. H. Bell, Oakura ..	2 14	241.9	365	6,948.0	449.44
Miro Meadow's Rita ..	A. A. Ward, Tariki ..	2 35	244.0	365	6,708.3	432.18
Pretty Kate ..	L. M. Barriball, Waiuku	1 338	240.5	365	7,748.5	431.28
Meadowvale Peg o' my Heart	E. O'Sullivan and Sons, Tariki	1 359	240.5	364	7,685.8	421.35
Meadowvale Sister Susy	E. O'Sullivan and Sons, Tariki	2 0	240.5	365	8,032.5	420.82
Avoca's Clematis ..	R. J. W. Hancock, Waitara	2 44	244.9	365	6,904.6	420.04
Twylsh's Primrose ..	D. M. Finnie, Westmere	2 22	242.7	364	6,666.75	416.03
Eileen's Neathead ..	F. V. Bryant, Ruawhata	1 284	240.5	342	8,935.6	414.72
Brooklyn's Betty ..	H. J. Lancaster, Glen Oroua	2 69	247.4	365	7,474.4	411.12
Hillcrest's Nova Aquilae	S. R. Lancaster, Palmerston North	2 52	245.7	308	6,781.5	405.57
Meadowvale Sheila ..	E. O'Sullivan and Sons, Tariki	1 352	240.5	340	5,588.5	369.06
Oakside's Quickstep	Mrs. M. A. Gadsby, Stratford	2 34	243.9	347	5,091.6	362.61
Ku Ku's Blossom ..	R. L. Horn, Manakau	1 347	240.5	365	6,549.9	360.46
Miro's Silvery ..	G. T. Gibbons, Ngaere	2 53	245.8	365	6,689.4	353.30
Jersey Brae's Prim's Beauty	T. Church, Te Rapa	2 33	243.8	364	5,815.2	325.41
Treasure ..	F. E. Day, Tamahere	2 40	244.5	365	5,542.9	301.42
Crofton's Dolly ..	A. J. Luxton, Omata..	2 0	240.5	285	5,237.6	291.11
Très Chic ..	E. H. Linnell, Midhurst	2 47	245.2	327	5,381.1	290.60
Orange Dale's Lady..	W. J. Hall, Matatoki..	2 12	241.7	365	5,379.4	286.93
Crofton's Fairy ..	A. J. Luxton, Omata..	1 334	240.5	282	5,357.6	283.58
Sylvia's Princess ..	G. H. Bell, Oakura ..	2 23	242.8	320	4,251.6	282.74
Harmony Girl ..	A. J. Luxton, Omata..	1 331	240.5	261	4,479.2	274.68
Sultan Mary's Fancy	Murray Bros., Stratford	2 28	243.3	278	4,592.5	263.53
Jersey Brae's Golden Dawn	T. Church, Hamilton	1 357	240.5	284	4,514.3	243.30

LIST OF RECORDS—continued.

Name of Cow and Class.	Tested by	Age at starting Test.	Fat req'd. for Cert.	Yield for Season.		
				Days.	Milk.	Fat.

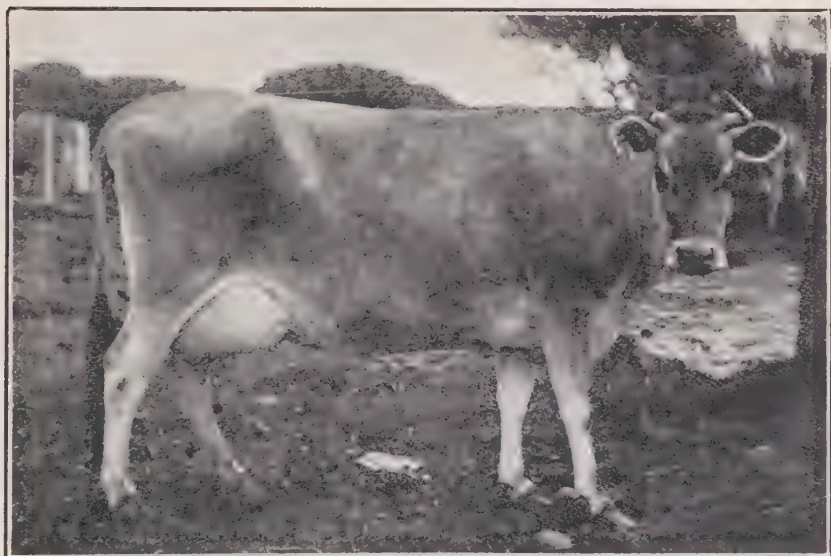
JERSEYS—continued.

<i>Senior Two-year-old.</i>		Y. dys.	lb.		lb.	lb.
Peter Pan's Bright Eye	L. W. and J. F. Prosser, Leeston	2 364	276·9	365	11,931·2	601·94
Avoca's Lady ..	J. Fulton, Whangarata	2 353	275·8	365	8,254·5	501·09
Charmeuse ..	F. S. McRae, Palmerston North	2 255	266·0	365	6,841·2	458·76
Dominion Diamond..	Ruakura Farm of Instruction	2 338	274·3	365	6,429·4	383·20
Dominion Dainty ..	Ruakura Farm of Instruction	2 322	272·7	365	7,440·1	372·28
Onaero's Heather ..	H. Wells, Hawera ..	2 328	273·3	365	6,514·7	362·25
Idem ..	L. McPhillips, Hawera	2 115	252·0	341	5,136·5	330·81
Jersey Brae's Rata Queen	A. J. Edwards, Ohaupo	2 361	276·6	292	5,234·1	307·30
Beatrice Chase ..	W. J. Hall, Matatoki..	2 299	270·4	365	5,410·9	272·99
<i>Three-year-old.</i>						
Zinokin ..	W. J. Chynoweth, Hamilton	3 97	286·7	365	8,945·2	641·71
Ngatina ..	F. C. Starck, Normanby	3 352	312·2	365	11,651·5	629·43
Perfect Day ..	H. Wells, Hawera ..	3 326	309·6	365	9,467·5	520·35
Red Velvet ..	M. Crimmins, Waikino	3 89	285·9	356	6,059·75	405·42
Neat Fame ..	S. R. Lancaster, Palmerston North	3 169	293·9	365	6,880·5	355·75
Orielton Amber ..	B. Tripp, Glen-iti, Timaru	3 68	283·8	220	6,087·3	300·78
<i>Four-year-old.</i>						
Sylvia of O.K. ..	G. H. Bell, Oakura ..	4 328	346·3	365	11,926·6	692·49
Frivolous Jessamine	W. J. Anderson, Levin	4 269	340·4	365	11,901·35	680·57
Pulchra's Queen ..	A. L. Hooper, Stratford	4 44	317·9	365	12,585·1	656·19
Merrivonia's Violet ..	G. H. Bell, Oakura ..	4 33	316·8	365	9,478·9	552·22
Fox's Donah ..	H. H. Phillips, Te Rehunga	4 36	317·1	365	7,670·7	468·17
Pink Chase ..	W. J. Hall, Matatoki..	4 223	335·8	365	7,629·3	446·60
Maori Wonder ..	R. Clark, jun., Waiau Pa	4 17	315·2	365	7,063·9	420·37
Orielton Banksia ..	B. Tripp, Glen-iti, Timaru	4 48	318·3	312	7,528·7	379·63
Honey Sweet ..	T. Church, Te Rapa..	4 290	342·5	286	6,420·6	366·80
Fox's Freda ..	S. R. Lancaster, Palmerston North	4 356	349·1	239	6,289·25	362·02
<i>Mature.</i>						
Belvedere Bilberry ..	W. Pollock, Stratford	10 55	350·0	365	11,618·0	589·42
Good Spec..	W. J. Chynoweth, Hamilton	5 322	350·0	365	9,963·6	579·41
Kotiro ..	Murray Bros., Opotiki	6 279	350·0	365	10,153·8	550·79
Ku Ku's Bossy ..	R. L. Horn, Manakau	5 6	350·0	365	10,167·7	541·53
Lassie's Duchess ..	T. Ranford, Whakaronga	9 287	350·0	365	8,360·8	536·12
Cherry's Chaka ..	V. W. Nowell, Hawera	5 293	350·0	317	8,449·8	514·89
Majesty's Neathead..	S. R. Lancaster, Palmerston North	9 7	350·0	292	8,905·5	513·66
Breezy ..	A. J. Smith, Cardiff ..	6 2	350·0	363	10,526·3	509·57
Country Beauty ..	A. G. Hynes, Inglewood	5 257	350·0	365	7,472·75	483·07
The Very Pattern ..	A. H. Guy, Mangatoki	9 351	350·0	365	8,269·3	469·07
Twylish Briar Flower	F. E. Day, Tamahere..	5 334	350·0	365	8,248·8	441·33
Asphodel ..	E. P. Binns, Feilding..	10 32	350·0	365	7,757·86	440·02



OAKWOOD RAMBLER (W. D. HUNT).

C.O.R. : 6 years 252 days ; in 365 days, 23,952·6 lb milk, 820·93 lb. butterfat.



NGATINA (STARCK AND LAURENT).

C.O.R. : 3 years 352 days ; in 365 days, 11,651 lb. milk, 629·43 lb. butterfat.

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at starting Test.	Fat req'd. for Cert.	Yield for Season.		
				Days	Milk.	Fat.
JERSEYS—continued.						
Mature—continued.		Y. dys.	lb.		lb.	lb.
Eileen Brisbane ..	F. V. Bryant, Ruawhata	7 274	350·0	340	10,042·7	427·95
Rewa Aster ..	W. H. Booth, Carterton	8 20	350·6	301	7,162·2	362·37
Rioter's Chase ..	W. J. Hall, Matatoki..	5 114	350·0	320	6,593·4	352·65
FRIESIANS.						
Junior Two-year-old.						
Coldstream Lady Holland	Marchant and Sons, Cardiff	1 354	240·5	353	8,736·9	407·42
Belle King Segis ..	H. W. Hoskin, Mangatoki	2 1	240·6	303	10,694·5	383·69
Pearl of Norfolk Park	W. Potter, Mangere ..	2 139	274·4	365	9,793·4	347·13
Pareora Lady Colantha	A. S. Elworthy, Timaru	2 42	244·7	365	8,273·0	309·29
Senior Two-year-old.						
Sheila ..	M. Fletcher, Auckland	2 353	275·8	365	11,021·2	432·70
Butter Girl of Groteholm	A. S. Elworthy, Timaru	2 333	273·8	365	10,824·0	398·53
Medbury Dutch Buttercup	G. H. Hassell, Clarkville	2 303	270·8	308	10,947·2	396·30
Heilo Salo ..	W. Barton, Featherston	2 301	275·6	342	12,115·3	377·82
Daisy Segis of Norfolk Park	W. Potter, Mangere ..	2 194	259·9	365	8,655·8	300·38
Junior Three-year-old.						
Salma Hope de Kol..	W. Barton, Featherston	3 175	294·5	365	16,791·1	551·58
Ongarue Dirk Beauty	Knight and Sons, Ongarue	3 63	283·3	209	9,101·2	285·97
Senior Three-year-old.						
Ongarue Netherland	Knight and Sons, Ongarue	3 363	313·3	365	16,443·5	576·78
Junior Four-year-old.						
Know-not Pride ..	W. Dew, Riverlea ..	4 43	317·8	365	21,424·9	700·55
Magpie Pietertje Maid	Marchant and Sons, Cardiff	4 6	314·1	365	16,327·8	653·85
Senior Four-year-old.						
Queen Colantha Cadillac	W. I. Lovelock, Palmerston North	4 223	335·8	365	21,440·3	803·19
Arena Lovely Colantha	Parkinson Bros., Opoitiki	4 344	347·9	365	14,888·8	437·69
Mature.						
Pontiac Princess ..	Marchant and Sons, Cardiff	5 335	350·0	365	20,843·4	831·10
Colantha la Favourite	Marchant and Sons, Cardiff	6 26	350·0	365	22,351·6	810·75
Fayne Segis Galatea	T. Perry, Mangatoki..	7 5	350·0	365	22,429·3	776·90
Segis Galatea ..	H. W. Hoskin, Mangatoki	7 37	350·0	297	17,717·1	624·99
Bainfield Delhurst ..	W. D. Hunt, Waikiwi	6 136	350·0	365	16,055·4	618·77
Clothilde's Alcartra..	H. W. Hoskin, Mangatoki	8 305	350·0	365	15,902·6	605·45
Woodcrest Netherland Princess	Marchant and Sons, Cardiff	5 313	350·0	318	15,231·1	582·47
Woodcrest Daisy ..	Central Development Farm, Weraroa	9 247	350·0	303	14,716·1	515·23
Riverlea Maudie de Kol	Knight and Sons, Ongarue	6 199	350·0	365	13,350·0	510·09

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at starting Test.	Fat req'd. for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
FRIESIANS— <i>continued.</i>						
<i>Mature</i> — <i>continued.</i> Kittanora Lady Inka	H. W. Hoskin, Manga- toki	Y. dys. 8 296	lb. 350·0	365	13,716·6	412·65
Etta Challenge Jo- hanna	Parkinson Bros., Opo- tiki	5 327	350·0	365	12,876·8	409·81
Magnet de Kol Burke	J. Young, Opotiki ..	7 15	350·0	276	11,502·4	405·80
Clothilde Corona Burke	Parkinson Bros., Opo- tiki	5 185	350·0	337	13,678·8	397·61
MILKING SHORTHORNS.						
<i>Mature.</i> Willowbend Mona ..	J. Smith, Dannevirke	..	350·0	365	12,760·0	494·10
Leeston Pet ..	J. Smith, Dannevirke	..	350·0	365	10,264·75	486·06
Terrace View Straw- berry	T. de la Haye, Wood- ville	..	350·0	357	12,371·5	482·02
Glenthorpe Queenie..	A. J. Melville, Buckland	..	350·0	355	9,026·5	409·86
Hukerewai Spot ..	A. D. Bell, Clevedon..	..	350·0	365	9,851·2	377·54
Champion IV of Corn- wall Park	J. Smith, Dannevirke	..	350·0	319	9,683·75	359·35
AYRSHIRES.						
<i>Two-year-old.</i> Maesgwyn Hazel ..	C. M. Williams, Ohoka	2 93 249·8	365	12,309·95	431·59	
SECOND-CLASS CERTIFICATES.						
JERSEYS.						
<i>Mature.</i> Blue Dolly ..	A. J. Luxton, Omata..	7 337	350·0	365	9,229·5	491·89
Bignonia ..	A. J. Luxton, Omata..	5 347	350·0	304	8,022·3	422·45
MILKING SHORTHORNS.						
<i>Senior Two-year-old.</i> Waitangi Ruby ..	A. J. McGovern, Kiokio	2 363	276·8	365	10,023·9	432·64
<i>Mature.</i> Dairymaid ..	G. N. Bell, Palmerston North	..	350·0	365	15,349·9	722·72

Rabbit Districts.—The constituting of the Mangapiko and the Wangaehu Rabbit Districts, in the Auckland and Wellington Land Districts respectively, was gazetted on 17th November.

Board of Agriculture.—Mr. E. D. McLennan, of Papakura, has been appointed a member of the Board of Agriculture, representing the Auckland District, in place of Mr. J. Massey, resigned.

Inoculation against Blackleg.—The number of calves sent forward for inoculation by officers of the Live-stock Division in the blackleg areas has decreased steadily during the past few years, indicating that fewer calves are being kept for raising than formerly. The numbers inoculated in the year ended 31st March, 1921, were as follows, the previous year's numbers being given in brackets: Auckland, 56,944 (98,500); Taranaki, 40,630 (45,667).

WORK FOR THE COMING MONTH.

THE ORCHARD.

THE position regarding fireblight remains somewhat reassuring in those districts where hawthorn has been declared a noxious weed by the local bodies and cutting-back has been thoroughly carried out. In such localities the disease has not yet been reported as making its appearance this season. This augurs well for the commercial district around Henderson, and it is hoped that the present brighter outlook may continue. In adjoining districts where hawthorn has not been declared a noxious weed, and consequently has not been treated, infection is rife, as it also is throughout the Waikato and other districts where infection has existed during the past two seasons. So far infection has not been reported from any district which was not previously infected. However, vigilance should not be relaxed anywhere, and every fruitgrower is enjoined to keep an ever-watchful eye on his own and neighbours' trees and immediately report any suspicious symptoms. So far this season's experience tends to prove the direct connection between the presence of hawthorn and the spread and recurrence of the disease. It would appear useless to attempt the control of fireblight in any locality where hawthorn is not prevented from flowering.

Pear-midge having made its appearance in some orchards in the Nelson District, fruitgrowers there and elsewhere in the South Island should keep a careful watch on pear-trees, especially young ones, and immediately report to the local Orchard Instructor any suspicious symptoms so that any outbreak may be promptly dealt with. In younger orchards, and to the raisers of pear-stock, this pest is practically as serious as fireblight; therefore the matter of early control becomes of extreme importance. Growers are referred to the article, "The Pear-leaf-curling Midge," by the Department's Entomologist, Mr. D. Miller, published in the *Journal* for August last.

The Orchard-tax Act has been given an extended lease of life, the amending Act, extending its operations until 1926, having been passed through all stages in the Legislature during the past month.

—W. T. Goodwin, Assistant Director of the Horticulture Division.

AUCKLAND.

Dry and hot weather usually commences this month, therefore cultivation of the soil should not be neglected if beneficial results are to be obtained from recent rains.

Spraying operations should be continued as follows: Apples—For the control of codlin-moth, black-spot, red spider, and mildew use arsenate of lead (3 lb. paste or 1½ lb. powder) and 7 pints lime-sulphur to 100 gallons water. Pears—Use arsenate of lead as for apples, combined with bordeaux, 3-4-40. All pip-fruits should be sprayed about every seventeen days until within a short time of picking. Where ripe-rot is likely to be prevalent, spray stone-fruits with lime-sulphur, 1-125. Carefully pick off and destroy any mummified fruits. This disease usually commences where fruits are touching each other. Spray citrus fruits with lime-sulphur, 1-125.

A sharp lookout should be kept for any late infection of fireblight; this will be noticed in the young tender shoots turning black. Ooze is often very prevalent in this class of infection, and the shoots should be cut out immediately this is noticed, otherwise a great deal of later infection will take place.

All young trees should be gone over and a little careful pinching of young misplaced shoots carried out. This will do much to balance up the limbs. When packing fruit for the market too much care cannot be taken to place an even and honest pack in the market. This will bring its reward.

—L. Paynter, Orchard Instructor, Hamilton.

HAWKE'S BAY.

The harvesting of early varieties of fruit will now demand attention. Peaches should be picked while still firm, though not until they are of full size and well coloured. Pack separately the various grades according to size and maturity, handle carefully, and do not pack soft-ripe or skin-punctured specimens except for immediate local consumption. While there may be little or no brown-rot showing in the orchard, there is every chance that such may develop within a day or so of picking-time, or after the fruit has been packed into cases.

Aim to have the trees sprayed with lime-sulphur, 1-120 on peach and nectarine, and 1-100 on plum trees, a week or so before picking.

For codlin-moth and leaf-roller caterpillar arsenate of lead should be applied about every third week, or at shorter periods if necessary, to keep a protective coating on the rapidly advancing fruit; use $1\frac{1}{2}$ lb. of paste or $\frac{3}{4}$ lb. of powder to 50 gallons of water. Pear and quince trees in bearing are usually well protected against cherry or pear slug by the arsenical coating applied for codlin-moth. On non-bearing pears and quinces apply arsenate of lead as for codlin-moth. The same applies to plums, except that when the fruit is nearing ripeness hellebore powder may be used. Though rather less effective, the latter is non-staining, and may be used right up to picking-time at the rate of $\frac{1}{2}$ oz. to each gallon of water.

Red mite may be expected to hatch from summer eggs during the next few weeks, but three applications of lime-sulphur, 1-100, at intervals of a week should give satisfactory control. Black Leaf 40 is equally effective, and may be substituted instead of one lime-sulphur application when woolly aphis is present. With the more settled weather expected from now on black-spot should not be troublesome, and control may be obtained from the lime-sulphur, 1-100, applied for other purposes. The same spray should also keep down powdery mildew, but atomic sulphur, 4 lb. per 100 gallons, should be added if this is any way bad.

For woolly aphis Black Leaf 40, 1 pint to every 100 gallons, should be applied under a good pressure. Black Leaf 40 can also be applied as a combined spray with arsenate of lead, or lime-sulphur, or both, though in this case the milk made from 3 lb. of fresh lime must be added to every 100 gallons of the mixture.

—W. H. Rice, Orchard Instructor, Hastings.

NELSON.

The spraying notes given last month still apply. Results depend on vigilance; get accustomed to observing the first signs of trouble and taking prompt action. Brown-rot has perhaps exacted the heaviest toll at this period of the season in the past. For the present, go over the trees susceptible to this fungus once a week, collecting affected fruit and twigs and carefully destroying them. Spray thoroughly up to within a fortnight of picking. Indeed, an application or two of lime-sulphur on stone-fruit trees after the crop is gathered would often be beneficial.

See last month's notes regarding the picking and packing of the stone-fruit crop. Should the weather be dry, maintain a good clean tilth in the orchard throughout the month. Some vigorous young trees six or seven years of age, mostly pears, will require summer pruning to bring them into bearing. This is a most effective treatment, and should be done towards the end of the month as wood-growth ceases. During the first month or two in the New Year budding may be done with best results.

—W. C. Hyde, Orchard Instructor, Nelson.

MOTUEKA.

Many growers in this district have only a medium crop this season, and consequently might be inclined to neglect spraying to a certain extent. Where the crop is small the fruits should be exceptionally good if the best returns are to be secured, consequently all necessary spraying should be done towards that end. Codlin-moth, leaf-roller, and pear-slug will do much damage if spraying is neglected. Keep the fruit well covered with arsenate of lead during the month. Use Black Leaf 40 against any new colonies of woolly aphis appearing on the younger wood. Further spraying for the control of black-spot will be necessary, lime-sulphur at a strength of 1-120 being used. This should also be effective against powdery mildew and red mite.

Do not neglect cultivation during January. Trees will require all the moisture they can get for the successful development and maturing of the crop. This is best done by keeping the surface soil in good condition—going over the orchard with the harrows after every shower of rain.

During the month growers of stone-fruits will be busy harvesting and marketing. Remember it is always advisable to make several pickings from each tree, selecting only those that will be in best condition when placed on the market. Let the fruit be firm, of good size, and well coloured when packed, and do not delay getting it to the market. Put up in the best possible manner, remembering that the best article always commands the highest price. Trays and crates should be used for any extra-fancy fruits, using the ordinary cases for second-grade lines. Brand correctly and legibly—not forgetting the registered number—and let the contents of the package be as stated on the outside.

—G. Stratford, Orchard Instructor, Motueka.

NELSON CENTRAL.

Spraying operations for the month will be on much the same lines as those of last month, except that the strength of lime-sulphur used should be 1-120, or a further reduction of this material made and a greater proportion of atomic sulphur used with it, especially in combination sprays, in order to reduce the risk of burning. Spray regularly with arsenate of lead for control of codlin-moth and leaf-roller caterpillar. All infected fruits should be picked and destroyed before the grub has a chance to escape.

Thinning of fruit can still be carried out with advantage, taking care to remove those affected by black-spot, beetle-marks, &c.

The more-forward fruits on early varieties of apples will soon be ready; select the more-matured specimens from the trees and catch the early market, taking care not to send forward immature fruits for dessert purposes. Cooking sorts, such as Alfriston, Lord Suffield, Keswick Codlin, Alexander, &c., can be profitably culled as soon as sufficient size and development has taken place.

Cultivation should be well maintained, keeping the land in good tilth and ready to receive a green crop, preferably blue lupin, which should be in during January to obtain the best results.

—J. H. Thorp, Orchard Instructor, Mapua.

CANTERBURY.

Spraying measures for the month of January should be carried out as follows: Pip-fruits—For codlin-moth, pear-slug, and leaf-roller use arsenate of lead as previously advised. For woolly aphis, red mite, and apple-leaf hopper use lime-sulphur, 1-100, or Black Leaf 40, 1-1,000, plus 3 lb. of soap per 100 gallons. For black-spot on apples apply lime-sulphur, 1-100, and on pears lime-sulphur, 1-100, or bordeaux, 3-4-50. For powdery mildew apply atomic sulphur, 8 lb. to 100 gallons, or lime-sulphur, 1-100.

Stone-fruits: Keep a sharp lookout for brown-rot, which is very prevalent in this district this year. Spray the trees with lime-sulphur about ten days before picking the fruit. For cherry-slug, while crop is on the trees, use hellebore powder; after picking, arsenate of lead may be used. For other insect pests and for fungus diseases apply lime-sulphur, 1-125.

When the soil becomes dry enough for working keep it well stirred so as to conserve moisture during the critical period of fruit-development.

Remove all suckers from trees. This is an important work which is too often neglected.

The reworking of trees by budding may be carried out during the last week in January and in the month of February. Summer pruning should be practised only where really necessary. The time for doing it is towards the end of January. In the past much damage has been done by injudicious summer pruning.

Stone-fruit growers will be busy harvesting their crops. These fruits must be handled very carefully so as to prevent them from being damaged, otherwise returns will be poor. They should be gathered when they have reached full size and colour but are still firm. The best results are obtained by making from three to four pickings at different periods from the same trees.

—W. K. Dallas, Orchard Instructor, Christchurch.

OTAGO.

Cultivation is often neglected at this period of the season owing to early varieties of fruits requiring picking. Every effort should be made to maintain a good tilth, otherwise the later varieties suffer.

Keep a close watch for black-spot, especially on pears and Cleopatra and Delicious apples. Lime-sulphur, 1-100 to 1-120, should be used on apples to keep this disease in check. Where black-spot is noticed on pears, bordeaux, 3-4-50, may be used, as this fruit does not russet like apples. As powdery mildew is very prevalent this season, the use of lime-sulphur, 1-100 to 1-120, or atomic sulphur, 8 lb. to 100 gallons, is recommended, applications to be made at intervals of not longer than three weeks. When using lime-sulphur it is advisable to add 3 lb. of atomic sulphur to every 100 gallons, as this gives the mixture more body, and lessens the likelihood of damage to the foliage.

When red mite is present on stone-fruits three applications of lime-sulphur, 1-125, at weekly intervals, will be found to satisfactorily control this pest. Black Leaf 40, 1-800, is equally effective, and can be substituted with advantage where woolly aphis is present. In cases where the black or green aphis of the peach is still troublesome McDougall's Insecticide, at a strength of 1-50, or Black Leaf 40, 1-800, should be applied. For cherry or pear slug apply arsenate of lead, 3 lb. paste or 1½ lb. powder to 100 gallons. On ripening fruit use hellebore powder, 1½ lb. to 50 gallons.

For codlin-moth, leaf-roller, &c., arsenate of lead, 3 lb. paste or 1½ lb. powder to 100 gallons, should be periodically applied to keep the rapidly growing fruit covered with a protective coating. This can be applied as a combined spray with lime-sulphur, Black Leaf 40, atomic sulphur, or bordeaux.

—B. G. Goodwin, Orchard Instructor, Dunedin.

POULTRY-KEEPING.

F. C. BROWN, Chief Poultry Instructor.

Now that the young stock are reared to what may be termed a safe age, the coming month will mark a more or less slack period on the poultry plant. The steadily increasing cost of foodstuffs, in contrast to the present reduced market value of eggs, with the consequent reduced margin of profit over the cost of production, emphasizes the necessity of good management and a keen eye towards economy in every phase of the business. It is the little things that count most in poultry-keeping, and care in these may easily make the difference between success and failure. Among other things, the following should not be overlooked: Thoroughly clean and disinfect the incubators; wash the lamps as well as the burners in boiling water, and then thoroughly dry. These, together with the regulating-devices (connecting-rod, &c.), should be placed inside the incubator. This will not only ensure that these parts are in good working-order when required next season, but, in addition, the life of the incubator will be greatly prolonged. Incubators are now high in price, and, like any other machine, they must be specially cared for if they are to hatch a maximum number of chicks and have a long period of usefulness. A good incubator should last a lifetime if handled and treated in a common-sense manner; thus a few minutes spent on the lines indicated will be well repaid in the long-run.

With the breeding season over, all male birds should be separated from the hens. Remember that the latter will lay as well, if not better, without the males. Any males that show signs of not being serviceable for future breeding purposes should be disposed of at once. It is seldom that these can be depended upon to fertilize even a decent percentage of eggs after the third year, and keeping such stock means a continued drain on the profits. It is not economical to retain cockerels intended for market beyond an age of four and a half to five months. Separate the sexes before the male birds commence to crow; this will be to the advantage of both sexes. In getting cockerels ready for market the smaller the number in a pen the better the results, while a limited amount of range will also tend towards rapid flesh-development. Of course, the birds should be liberally and frequently fed with good wholesome food. Do not waste time in doctoring a sick bird or trying to rear a weak chicken. Such time would be better spent in doing work which will benefit the whole flock, such as keeping the houses clean

—one of the chief secrets in preventing disease and insect pests from making their appearance.

Although foodstuffs are dear, it is poor economy to stint fowls of their food, or to provide an inferior ration. It is always a sound policy to reduce the flock rather than the ration. When suitable land is available every endeavour should be made to grow substitutes for costly grains. In this connection the value of a patch of lucerne cannot be overestimated; it serves a dual purpose, inasmuch as it can be fed in a green chaffed form during the greater part of the year, while any surplus can be made into hay for winter use. Finely chaffed lucerne hay, steamed or boiled overnight and mixed in the morning mash, will not only be relished by the birds but will greatly tend towards promoting egg-production, while, in addition, it also to a great extent replaces more costly foods. A good patch of lucerne, and a small chaffcutter with which to chaff it, will prove a big factor towards effecting economy on the average poultry plant.

EARLY CULLING.

While the general culling of hens should not take place until March, there are, however, few plants on which good weeding-out work cannot be carried on now. Every bird which fails to show a profit over the cost of production reduces the earning-power of the flock; thus there should be no sentiment or delay in culling out doubtful stock. It must be admitted that the work of culling at this season of the year has to be carried out with considerable judgment, or the good layer is apt to be discarded and the poor one retained in the flock. As an instance, it will generally be found that the heaviest layer has the most shabby appearance—a worn plumage and bare head—and will usually be found in a more or less lean condition. On the other hand, the birds possessing the greatest weight and the best-kept plumage are the drones. A keen student of laying form visiting the average auction-mart cannot fail to see some of the best laying-types of bird in the country being marketed long before they have finished their best season of production, this being due solely to their rough appearance, and to ignorance on the part of their owners in not knowing that the apparent worse-for-wear condition of the birds is entirely due to heavy egg-production. In addition to bearing a shabby appearance, the good layer of the yellow-skinned breeds—White Leghorn, Plymouth Rock, Wyandotte, &c.—will exhibit at this period of the year a well-bleached pair of shanks and a white beak, quite irrespective of the rich yellow colour they may have possessed during the pullet stage.

A further indication of good laying-capacity will be found in a pinky-white condition of the parts surrounding the vent. In the poor layer the parts referred to will present a bright yellow colour, while the bird will generally be found in an overfat condition. These latter signs indicate that the bird is turning the bulk of its food into surplus flesh and fat instead of eggs, and it should therefore be got rid of at once. It should be remembered that the colour-points referred to only apply towards the end of the bird's laying season, as even with the best of layers the legs, &c., will regain a yellow appearance after the moulting process has been undergone. Then again, like any other rule, this one is not capable of universal application.

Thus in culling fowls all the circumstances surrounding the flock should be taken into consideration. For example, where birds have access to well-grassed runs, the leg-colour, even with the best layers, will not diminish to the same extent as when they are kept in a dry, bare run. In most things connected with poultry-keeping local conditions must always be fully taken into account, and no exception can be made in the case of culling the flock.

OAT-HUSKS.

Several cases have recently come under my notice where healthy-looking hens in a laying-condition have died suddenly for no apparent reason. On a *post mortem* examination being made, however, the cause of the mortality was revealed: the gizzards were found to be absolutely packed with oat-husks. The ration provided in each case consisted largely of inferior-quality oats, which meant the birds had to consume an excessive amount of this food in order to secure the good meal which the heavy layer demands. Thus the amount of fibrous material eaten was beyond the bird's capacity to digest, and consequently death followed.

The examination of each bird also disclosed the fact that the only form of grit in the gizzard was soft sea-shell, which was no doubt to a great extent responsible for the mortality. Where a heavy oat ration is being supplied, and

especially when the quality is not good, sharp gravel grit in addition to crushed sea-shell should always be available for the birds to pick at, the former to assist digestion and the latter as an egg-shell-forming material. Of course, it is always a penny-wise-and-pound-foolish policy to feed fowls on poor-quality oats.

THE APIARY.

F. A. JACOBSEN, Apiary Instructor.

USE OF QUEEN-EXCLUDERS.

THE season is now at hand when it is advantageous to use queen-excluders. During the height of brood-rearing, in order that the queen may not be cramped, she should be allowed the full use of the super, so that a large number of worker bees may be raised to harvest the crop. It is not wise to bring the excluders into use too early, and as a rule this should not be done until the bees are working freely in the super. By cramping the queen in a small brood-chamber the swarming instinct is stimulated, and the increase in population of bees is also very materially curtailed. Every encouragement must be given to the queen to lay to her utmost, as by so doing strong colonies are built up. The best time to put the excluders on the hives is when the main flow sets in and the bees are bringing in the nectar. Too many beekeepers make the mistake of putting them on when they add the first super, and, as it is not an easy matter to induce the bees to pass freely through this obstruction to the upper chamber even when frames of honey are raised, there is often considerable delay in establishing free communication.

Before placing the excluder in position examine the colony and note the amount of brood. If the lower chamber is full of brood the combs may be manipulated so as to provide the queen with ample room for laying during the period to follow. The plan is to remove the majority of the frames containing capped brood and place them above the excluder, substituting empty combs, and taking care to see that the queen is left below. As the bees hatch out over the excluder they will become accustomed to passing through it, and as fast as the cells become vacant they will be filled with honey. If eggs are raised with the brood, care must be taken that the bees do not raise queen-cells, for in this case the colony may swarm out, leaving in the super one or more virgin queens, which, being confined to the hive and thus prevented from mating, will develop into drone-layers. Within one week after lifting the brood to the super, examine it to ascertain if any queen-cells have been built, and destroy any found. The advantage of using queen-excluders after the commencement of the main honey-flow lies in the saving of labour in picking over the combs at extracting-time. It is only through the use of excluders that bee-escapes can be used, and in many seasons—depending largely on the weather—these have to be brought into use.

PROVISION OF SUPERS.

One of the necessities of a well-regulated apiary is an abundance of supers when the honey-flow is at its height. Every inducement should be given the bees during the often brief season to gather in every available drop of nectar. No beekeeper should allow his bees to cluster outside the hives for lack of storage room. It is well, when adding additional supers, to place them between the brood-chamber and the first super, or at least to raise a few frames of honey from the first super into the second when adding the latter. On no account should the beekeeper neglect to supply his swarms with super room. If the weather is normal a strong swarm should be provided with a super from five to fifteen days after it is hived. Not only is this necessary to provide for a surplus of honey, but also to prevent the new colony swarming again. A natural swarm is most vigorous, and will usually make more headway than an old-established colony. It should therefore be encouraged to settle down to honey-production by the provision of ample storage room. Many beekeepers fail to obtain maximum honey crops through not realizing that early swarms will invariably, if given adequate attention, produce a large surplus.

While advocating so strongly the provision of supers, it must be distinctly understood that the bees should not be discouraged by the provision of an excess of room at one time. No super should be added unless the bees are well forward with the previous one.

VENTILATION.

Abundant ventilation is required during the warmth of the summer in order to prevent overheated or scalded brood. Indications that ventilation is lacking are sometimes given by the bees—for example, when they cluster outside the entrance during the day or sometimes in the evening. In these cases an additional super may be necessary, or the placing of $\frac{1}{2}$ in. blocks between the corners of the brood-chamber and the bottom-board may remove the cause of trouble. When a large number of bees are seen at one side of the entrance desperately fanning with their wings it means that more air is required. It is considered that ventilation also plays a part in the ripening of the honey.

REQUEENING.

Attention was directed in last month's notes to this matter. Every bee-keeper should see that each colony is headed by a young queen from the best honey-producing and disease-resisting stock. If no queen of good quality is available to breed from it would pay to procure one from a reliable breeder and Italianize the apiary. The leather-coloured Italian bees have long been recognized as the best imported into this country. They are hardy and strong workers, and seem better able to withstand the attack of disease, due no doubt to their vigorous constitution.

PREPARATIONS FOR EXTRACTING.

Preparations should now be made to get the honey-house in a suitable order for extracting. Overhaul all machinery and equipment, and thoroughly clean everything that may come in contact with the honey. Section 14, subsection (d), of the regulations under the Sale of Food and Drugs Act provides that "every place used for or in connection with the sale, manufacture, preparation, storage, or packing of any food for sale shall, so far as practicable, be used for that purpose only; and no place shall be so used which is at any time used as a sleeping-apartment, or in which any animal is allowed to be or which is or has been used for any purpose which would be likely to contaminate such food or injuriously affect its wholesomeness or cleanliness."

VITICULTURE.

J. C. WOODFIN, Vine and Wine Instructor.

THE VINEHOUSE.

VENTILATION, regulated to maintain an adequate supply of fresh air and an equable temperature in the vinery, is essential to the favourable maturing of young grapes and the well-being of the vines. It should be so adjusted that no great variation is perceptible at once, but the change in temperature gradual. The greatest harm is done by allowing the sun to warm the house in the morning before any air is admitted, and then opening up all ventilators with the object of cooling the house. The result is that the warm air escapes and the temperature is suddenly reduced, causing a check to the growth of the vines—though this is not apparent at the time—and rendering them susceptible to disease.

A little ventilation should be given at the top early in the morning, as soon as the temperature is observed to be rising but before the sun shines on the house, and gradually increased during the day as the heat from the sun becomes stronger. It is then gradually reduced towards the evening, closing the house while the rays of the sun are still sufficiently powerful to secure a slight rise in the temperature after doing so. As the nights become warmer the top ventilator can be opened slightly before retiring, and left open all night.

Scalding is a trouble many people meet with. It is most general in houses that get the early morning sun, and which are situated, built, and ventilated in such a manner that they tend to become very hot. The period when scalding is most likely to occur is that known as the stoning-period. When the berries are first set they grow at a fairly rapid rate for some time, until they are about half-grown or more. Then for a period of about four or five weeks increase in size is very slow—the stones are forming. This is a critical time; scalding may occur, and mildew is easily started. During this period no attempt should be

made to hurry growth, and very little damping down or syringing should be done. The house should be kept rather cooler than before by means of the ventilators, and a little top ventilation should be left on all night. The object is to prevent the accumulation of moisture, and to avoid too great a difference between night and day temperature. Colour shows in the berries immediately after stoning is finished. Both heat and moisture can then be increased, as the early colouring-period is the time when the best swelling is made.

THE GARDEN.

W. H. TAYLOR, Horticulturist.

VEGETABLE-CULTURE.

THE last week in December and the whole of January should be a very busy time in the vegetable-garden. In the majority of places all the brassica family must be planted out during this period. My experience is that if planting extends into February only partial success can be expected. Brussels sprouts can hardly be planted too early, a long period of growth being necessary to get best results; they do fairly well if planted early in January, but that is quite late enough. All brassicas require a fairly strong and rich soil, brussels sprouts more so than any other species. A fair amount of humus is necessary, not only for its fertilizing-properties, but because it holds moisture and also encourages the formation of roots. Not infrequently plants growing on soil deficient in humus exhibit a diseased appearance, growth becomes feeble, and the leaves show yellow, brown, and black discolorations. This is not always due to bacterial or fungus diseases, but to what is termed malnutrition disease, caused by lack of proper plant-food.

Cauliflowers of the Autumn Giant type should be planted early in January at the latest. The heads come into cut during autumn, after peas and beans are past and before broccoli are ready, thus constituting a most valuable crop. Early varieties of cauliflower, such as Snowball, may be planted at the same time, but must not, however, supersede the Giant kinds, as they fill a different and less important role. Being quicker in growth they come in while summer vegetables are still available, and are merely useful to afford a change; for that reason they are not particularly important.

Leeks, which are generally regarded as a very important winter crop, should also be planted at the time stated for cauliflowers. Later planting is often done, but to get really first-rate leeks a later date will not answer. Where pressure of work or lack of garden-space rendered early planting difficult, my own plan has been to plant as many as possible at the time stated; then if more are wanted I let the seed-row stand and plant more in a month or so. The later planting always does well, but the specimens are smaller. Plants from a later sowing do not answer so well; they lack size to start with. The seed should have been sown about the middle of September, and left unthinned so as to produce tall, drawn-up seedlings, which are the kind wanted. At planting-time they should have a solid stem about 8 in. long, independent of the top leaves. The ground should be deeply worked and well pulverized—not merely on the top, but from the bottom upward. If possible, a liberal dressing of farmyard or stable manure should be given, but, failing this, humus of some kind is essential. If a fertilizer is to be used blood-and-bone will answer. Wood-ashes, or ashes and burnt earth from a rubbish-fire, are valuable, while a liberal dusting of soot, about 7 lb. per square rod, is also useful. Anything of this kind should be well worked into the soil. In planting, draw drills as though for peas, spacing them 18 in. apart. Set the leeks about 10 in. apart in the drills. The best planting-implement is a dibber made from a spade-handle. This is pressed into the soil till the handle nearly or quite touches the surface, and then twisted round to increase the circumference of the hole. A plant is let down as far as it will go into the hole thus made, and then lifted so as to straighten the roots. The dibber is then thrust into the ground a few inches from the hole, held at an angle with the point directed to the foot of the hole, and the handle brought upright close to the plant, using some force, so as to firm the soil against the plant from bottom to top. Some planters trim the roots and cut off the long tops before planting. I am opposed to either practice, though trimming is necessary if the plants are

done up in bundles and sent away for sale. When replanting is to take place immediately both tops and roots should be left intact, and the plants will start growing the sooner if this is done.

Broccoli, cabbages, savoys, and kale should be planted before January is past. Other current work includes the sowing of swede turnips, dwarf beans, turnips, lettuce, silver-beet, spinach, raddish, and a last sowing of peas.

The main planting of celery should be made now. In the warmer localities planting can extend to the end of February, but in cooler parts it is best to make the planting done about Christmas-time the last one. The heads will stand right through winter, increasing in size most of the time. In former times it was the custom to earth up gradually a little at a time as the plants increased in size, but very few present-day cultivators do so, though the practice is not entirely abandoned. It is a fact, however, that the plants grow strongest when not moulded up, and the best plan is to leave them open until sufficient growth has been made, and then mould in one operation. In either case a slight moulding is necessary soon after the plants start to grow freely. The lower leaves have a habit of spreading out more or less horizontally, and if left till they get set these cannot be lifted without being bruised or broken. For this reason sufficient soil should be firmly packed around the base of the plants to hold the lower leaves upright. Where rust is troublesome spray every twelve days with 2-2-40 bordeaux mixture.

The pulling of stalks from the summer varieties of rhubarb should now cease. All the stalks now on, and any more that may be made, should be left to die down on the plants. If this is not done a good spring crop, which is the most valuable of the year's growth, cannot be got. This is a plant that is specially benefited by stable manure; a good mulch applied now will do a great amount of good and have a marked effect on the spring crop.

Attend carefully to the suppression of side shoots in tomatoes. It is a mistake to allow the plants to make a lot of growth which must be cut off. Spraying should not be neglected, as it is necessary in all places except perhaps those that experience a very dry summer.

It may be well to again call attention to the necessity for using potash in conjunction with other fertilizers—particularly when a nitrogenous fertilizer is used to force growth—as it imparts vigour, makes growth firmer, benefits the fruit, and renders the plant less liable to disease. In this connection the following extract from a lecture by Dr. E. J. Russell, Director of the famous Rothamsted Experimental Station, should be noted: "Nitrogenous manures tend to a vegetative growth of large, deep-green leaves, which are somewhat liable to be attacked by fungus pests. . . . Potassic fertilizers improve the vigour of the plant, and increase its power to resist fungus attacks."

Land for Discharged Soldiers.—The following lands will be made available for discharged soldiers during the next two months: In Auckland Land District one section in the Pirongia Survey District, of an area of 163 acres, will be balloted for on 23rd January. Eight sections known as the Piu Settlement, in the Taranaki Land District, comprising an area of 2,100 acres in areas ranging from 140 acres to 402 acres, will be offered for general application, with preference to discharged soldiers, on 30th January. This settlement is situated some eight miles south-westward from Kopaki, which is a railway-station on the Main Trunk line, thirteen miles south of Te Kuiti. The land is suitable for dairying and sheep and cattle grazing.

Contagious Mammitis.—In his annual report for 1920-21 the Director of the Live-stock Division states that contagious mammitis does not appear to have been quite so prevalent throughout the dairying districts as formerly, and although a large number of samples of milk (739) from suspected cases were received at the Veterinary Laboratory for examination, only 169 were found to show the specific streptococci indicating the contagious form, while 143 proved the presence of other non-contagious forms. The fact of so many samples of milk from suspected cases of mammitis having been forwarded, and only a fairly small percentage of them proving to be from mammitis-infected cows, indicates that milking-machines have been the agency responsible for setting up udder troubles resembling mammitis. As milking-machines are also a big factor in the spread of the disease, it is necessary that the greatest care be taken to have the cups, &c., thoroughly cleaned and regularly sterilized, and the cows' udders examined by hand after each milking so that any abnormality might be at once detected and checked.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

MORTALITY AMONG YOUNG PIGS.

"PIG-FARMER," Kinohaku :—

I have four sows with their first litters (now about five weeks old) running together on fern land, and feed them twice a day with skim-milk. The suckers seem quite healthy, but sometimes one will take what seems to be a fit and die within a few hours. Can you enlighten me as to the cause of the trouble?

The Live-stock Division :—

The symptoms you describe may arise from various causes, chief of which are dietetic troubles. It is well known that when young pigs are fed on skim-milk, more especially if this is fed in a sour condition, they are liable to suffer as you describe, owing to the milk turning to a cheesy mass in the stomach. This, combined with more or less indigestible fern-root, is probably the cause of the trouble. We would advise that you shift the pigs to a fresh grass pasture, and add to the milk a little pollard which has first been steeped in boiling water.

FIELD-PEAS FOR HAY.

R. E. B., Te Rehunga, Dannevirke :—

I should be glad to learn if Prussian Blue peas make suitable hay if cut at the flowering-stage, as is customary with other legumes. If so used, what would be their feeding-value?

The Agricultural Instruction Branch :—

Prussian Blue peas make good hay if cut just when the pods form, and have a high feeding-value. When cropping them for this purpose it is a better practice to grow a mixture of oats or wheat and peas, in equal proportions, than to sow peas alone.

EGG-PRESERVATIVE.

"INQUIRER," St. Bathans :—

Will you kindly advise me as to a simple method of preserving eggs?

The Chief Poultry Instructor :—

You are recommended to use water-glass, which is obtainable from most chemists and storekeepers. This preservative is known to chemists as soluble silicate of soda, but is often sold under a trade name.

MAKING GREEN-HIDE LEATHER.

"SETTLER," Tolaga Bay :—

Will you kindly tell me if any other chemical could be substituted for sulphuric acid in making green-hide leather by the method detailed in the recipe given in the May *Journal*. Transportation of the acid to a back district such as this is very difficult. Would a freshly killed hide or one which has been salted for some weeks be most suitable?

The Live-stock Division :—

A fresh hide would certainly be preferable to a salted one. One thing which is most essential is to give the hide plenty of room in the solution to ensure an even curing. Also it should be handled every day for three or four days. In the place of sulphuric acid 6 lb. of alum to 4 lb. of coarse salt, dissolved in boiling water, may be used. This liquid should float a potato when at the proper strength. When cured the leather should be dried slowly and not exposed to the sun.

THE WOODLICE PEST.

D. J. BAYLISS, Hatuma :—

Will you please inform me how woodlice may be prevented from eating the leaves of young plants, and how they may be destroyed ?

The Horticulture Division :—

There is no known way of preventing these crustaceans from eating plants, so that the only remedy is to destroy them. They eat all kinds of vegetable matter, whether decayed or not. Often it is the collar of the plant just above the soil that is attacked, at times a ring being eaten right round the stem, causing the plant to collapse and die. Woodlice are nocturnal feeders, sheltering during the day in all sorts of places. They prefer dry situations, but do not mind damp caused by decaying boards. Crevices in the soil, between boards, under any kind of dry rubbish, between soil and boards, in dryish hay or farmyard manure, under dry lumps of cow-manure, in heaps of garden rubbish, in box edgings when such are rather tall, and among the foliage of dense-growing herbaceous plants, all provide suitable shelter for them. They object to being disturbed, so that frequent hoeing to prevent cracks and quiet corners will banish them from such places. Rubbish should never lie long without being turned over ; tall box hedgings should not exist ; and old boards should not be left lying about the garden. When their haunts are discovered boiling water will kill them instantly, and is the chief means of defence in the case of garden frames and anything of a similar character, such as fences, where they frequently are found between the rail and the palings. Creeping plants on banks of soil frequently harbour them. In such cases a thorough hoeing, repeated several times at intervals, will drive them away. Poultry eat them greedily, even young ducks and chicks being fond of them ; and places where poultry may be run can thus quickly be cleared of woodlice. Briefly stated, frequent disturbance of soil, prevention of accumulations of rubbish (unless this is frequently turned over, and imperishable material burned), the cleaning-up of any neglected places close to the garden, treatment by pouring boiling water in their haunts, and access of poultry where convenient form the chief means of controlling these destructive animals. The green frog, which is abundant in some districts, greedily eats woodlice, and if confined in a frame or greenhouse would soon dispose of them.

TREATMENT FOR COW BLOWN ON CLOVER.

"FARMER," Te Poi :—

Will you please inform me how to treat a cow that is blown on clover ?

The Live-stock Division :—

The treatment of this complaint differs according to its severity. In extreme cases, where an animal is in distress and where immediate relief is necessary, the animal should be punctured on the left side between the last rib and the hip-bone with a trochar and canula, and the gas allowed to escape. In milder cases, however, a few handfuls of dry bran given to the animal, or a stick tied across the mouth so that the jaws are kept moving, often has the desired effect. Should this fail to act, the following drench should produce beneficial results : 2 oz. tincture of ginger, 2 oz. hyposulphate of soda, and 1 quart of water. Turpentine and raw linseed-oil, materials which are found on almost every farm, can also be recommended in doses of two tablespoonfuls turpentine to 1 pint of raw linseed-oil well shaken up before administering.

THE SEASON'S LAMBING.

FOLLOWING are complete estimates of the current season's lambing, computed from estimated average percentages of lambs dropped, furnished by the Department's Inspectors of Stock in the various districts. Corresponding figures for the three previous years, together with the actual numbers of lambs tailed, are also given for comparison.

Year.	Number of Breeding-ewes.	Estimated Average Percentage of Lambing.	Estimated Number of Lambs.	Actual Number of Lambs tailed.
NORTH ISLAND.				
1921 ..	6,312,456	89·65	5,659,355	..
1920 ..	5,838,704	87·95	5,135,524	5,074,751
1919 ..	6,311,797	81·57	5,148,779	5,120,000
1918 ..	6,846,049	85·62	5,881,682	5,734,594
SOUTH ISLAND.				
1921 ..	5,835,332	83·28	4,859,425	..
1920 ..	5,729,845	80·20	4,595,426	4,539,797
1919 ..	5,996,709	72·23	4,331,883	4,326,385
1918 ..	6,175,981	76·50	4,728,391	4,750,777
DOMINION.				
1921 ..	12,147,788	86·59	10,518,780	..
1920 ..	11,568,549	84·11	9,730,950	9,614,548
1919 ..	12,308,506	77·02	9,480,662	9,446,385
1918 ..	13,022,030	81·50	10,610,073	10,485,351

FORTHCOMING AGRICULTURAL SHOWS.

Woodville A. and P. Association : Woodville, 24th and 25th January.
 Pahiatua A. and P. Association : Pahiatua, 27th January.
 Te Puke A. and P. Association : Te Puke, 2nd February.
 Clevedon A. and P. Association : Clevedon, 4th February.
 Feilding I., A., and P. Association : Feilding, 7th and 8th February.
 Matamata A. and P. Association : Matamata, 9th February.
 Dannevirke A. and P. Association : Dannevirke, 8th and 9th February.
 Masterton A. and P. Association : Solway, 14th and 15th February.
 Omaha and Pakiri A. and P. Association : Leigh, 15th February.
 Waimarino A., P., H., and I. Association : Raetihi, 16th February.
 Rodney Agricultural Society : Warkworth, 18th February.
 Rangitikei A. and P. Association : Taihape, 23rd February.
 Franklin A. and P. Society : Pukekohe, 24th and 25th February.
 Marton District A. and P. Association : Marton, 1st March.
 Katikati A. and P. Society : Katikati, 9th March.
 Ashburton A. and P. Association : Ashburton, 15th and 16th March.
 Murchison A. and P. Association : Murchison, 17th March.
 Hawke's Bay A. and P. Society : Hastings (Autumn Show), 21st and 22nd March.
 Mayfield A. and P. Association : Mayfield, 24th March.
 Methven A. and P. Association : Methven, 30th March.
 Temuka and Geraldine A. and P. Association : Temuka, 30th March.
 Oxford A. and P. Association : Oxford, 6th April.

(A. and P. Association secretaries are invited to supply dates and location of their shows.)

MEAT-FREEZING WORKS IN NEW ZEALAND, 1921-22.

Name and Address of Company.	Location of Works.	Beef-killing Capacity per Day.	Sheep-killing Capacity per Day.	Storage Capacity, in 60 lb. Carcases Mutton.
<i>Auckland.</i>				
Auckland Farmers' Freezing Company, Ltd., Auckland	Moerewa ..	200	2,000	100,000
" " " "	Southdown ..	200	3,000	126,000
" " " "	Horotiu ..	200	3,000	66,000
Westfield Freezing Company, Ltd., Auckland..	Westfield ..	200	3,000	205,000
R. and W. Hellaby, Ltd., Auckland ..	Westfield ..	120	500	3,000
East Coast Co-op. Freezing Company, Ltd., Whakatane	Whakatane ..	200	1,000	120,000
<i>Hawke's Bay.</i>				
Wairoa Farmers' Co-operative Meat Co., Ltd., Wairoa ..	Wairoa ..	100	3,000	165,000
North British and Hawke's Bay Freezing Company, Ltd., Napier	Westshore ..	50	2,500	40,000
Thomas Borthwick and Sons (Aus.), Ltd., Christchurch..	Pakipaki ..	30	1,500	64,000
Nelson Bros., Ltd., Tomoana	Tomoana ..	80	4,000	175,000
Hawke's Bay Farmers' Meat Company, Ltd., Hastings..	Whakatu ..	80	4,000	75,000
Poverty Bay Farmers' Meat Company, Ltd., Gisborne..	Waipara ..	150	4,000	270,000
Gisborne Sheep-farmers' Frozen Meat and Mercantile Company, Ltd., Gisborne	Kaiti ..	150	4,000	422,000
Ditto	Tokomaru Bay	60	3,000	140,000
" " " " " "	Hicks Bay ..	75	1,500	60,000
Nelson Bros., Ltd., Gisborne	Taruheru ..	85	2,500	100,000
<i>Taranaki.</i>				
Taranaki Farmers' Meat Company, Ltd., New Plymouth	Smart Road ..	125	2,000	160,000
Thomas Borthwick and Sons (Aus.), Ltd., Waitara ..	Waitara ..	200	2,000	82,000
New Zealand Meat Packing and Bacon Company (Co-operative), Ltd., Wellington	Eltham ..	60	..	25,000
Patea Farmers' Co-op. Freezing Company, Ltd., Patea	Patea ..	120	2,000	180,000
<i>Wellington.</i>				
Wanganui Meat-freezing Company, Ltd., Wanganui ..	Castlecliff ..	100	2,200	100,000
New Zealand Refrigerating Company, Ltd., Christchurch	Imlay ..	200	6,000	271,000
Otaihape Farmers' Meat and Produce Co., Ltd., Taihape	Winiaata ..	50	1,200	90,000
Feilding Farmers' Freezing Company, Ltd., Feilding ..	Aorangi ..	100	4,000	153,500
National Mortgage and Agency Company of New Zealand, Ltd. (Head Office, Dunedin)	Longburn ..	60	1,500	165,000
Wellington Farmers' Meat and Manufacturing Company, Ltd., Masterton	Waingawa ..	250	6,000	270,000
Gear Meat Preserving and Freezing Company of New Zealand, Ltd., Wellington	Petone ..	100	10,000	300,000
The New Zealand Meat Packing and Bacon Company (Co-operative), Ltd., Wellington	Ngahauranga ..	120	3,000	120,000
Wellington Meat Export Company, Ltd., Wellington ..	Ngahauranga ..	120	8,000	240,000
" " " " " "	Kakariki ..	100	2,000	90,000
<i>Marlborough.</i>				
New Zealand Refrigerating Company, Ltd., Christchurch	Picton ..	30	2,000	30,000
<i>Nelson.</i>				
Nelson Freezing Company, Ltd., Nelson	Stoke ..	30	500	50,000
<i>Canterbury.</i>				
Canterbury Frozen Meat and Dairy Produce Export Company, Ltd., Christchurch	Belfast ..	120	7,000	252,000
Ditto	Fairfield ..	..	4,000	100,000
" " " " " "	Paraora ..	25	4,500	233,000
New Zealand Refrigerating Company, Ltd., Christchurch	Islington ..	50	7,000	375,000
" " " " " "	Smithfield ..	50	6,000	304,000
North Canterbury Sheep-farmers' Co-operative Freezing Company, Ltd., Christchurch	Kaipoi ..	70	4,000	222,000
Thomas Borthwick and Sons (Aus.), Ltd., Christchurch..	Belfast ..	..	5,000	105,000
<i>Otago.</i>				
New Zealand Refrigerating Company, Ltd., Christchurch	Pukeuri ..	..	3,500	230,000
" " " " " "	Burnside ..	50	3,500	216,000
South Otago Freezing Company, Ltd., Balclutha ..	Finegand ..	50	2,500	175,000
<i>Southland.</i>				
Ocean Beach Freezing-works (J. G. Ward and Co., Ltd., Managing Agents), Invercargill	Ocean Beach ..	100	2,500	110,000
Southland Frozen Meat and Produce Export Company, Ltd., Invercargill	Mataura ..	50	2,000	104,000
Ditto	Makarewa ..	120	2,000	75,000
" " " " " "	Bluff ..	..	..	114,000
Totals	..	4,430	148,400	7,062,500